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AUTHOR	Childress, Ronald B.
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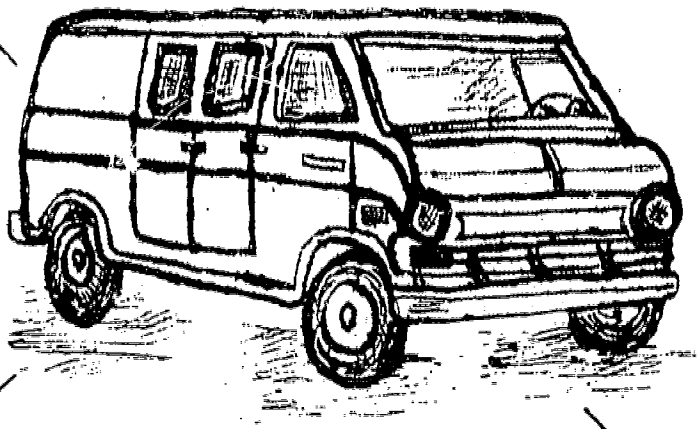
ABSTRACT

Envirpnmental investigations in this compilation were developed in conjunction with the establishment of a mobile environmental education laboratory, a demonstration project of the Kingsport (Tennessee) City School System. The 50 activities are divided into five categories: basic resources, environmental problems, living organisms, community relationship, and in-service activities. Within each category, investigations are further sub-divided into lower elementary, upper elementary, and secondary grade levels. Covering a wide range of subjects--air, water, soil, land use, geology, noise, vegetation, animals, forestry, weather, chemical reactions, recycling, population, communities, effects of man, etc., each investigation outlines suggested grade level, physical study area, equipment needed, theme and/or scope of the activity, objectives, procedures to follow, and interpretations or finding based on the research completed. Space is provided for completing data sheets and charts and answering questions. Thus, the manual may be used by both teachers and students, depending on the grade level. A related document is "Mobile Environmental Education Laboratory," SE 015 689. (BL)

INVESTIGATIONS FOR A MOBILE ENVIRONMENTAL EDUCATION LABORATORY

SCHOOL SITE DEVELOPMENT

COMMUNITY RESOURCE USE



IN-SERVICE TRAINING

STUDENT INVOLVEMENT

KINGSPORT CITY SCHOOLS
Kingsport, Tennessee

INVESTIGATIONS FOR A MOBILE ENVIRONMENTAL EDUCATION LABORATORY

KINGSPORT CITY SCHOOLS
KINGSPORT, TENNESSEE
1972

Superintendent of Schools
Dr. Ralph E. Evans

Project Director
Ronald B. Childress

INTRODUCTION

The curriculum materials contained herein are the result of a Summer Curriculum Development Workshop held June 12 - August 4, 1972. This workshop was funded by the Tennessee Valley Authority as a portion of a grant to the Kingsport City School System to develop, as a demonstration project, a Mobile Environmental Education Laboratory.

The primary project objective was to verify a new concept in environmental education by:

(1) providing inservice training to elementary (including preschool), secondary, and postsecondary education personnel to enable them to participate effectively in environmental education programs;

(2) developing material designed to assist the introduction of environmental studies in existing programs and/or strengthen the content of existing environmental programs at all educational levels;

(3) developing curricula which will provide useful learning experiences leading to an understanding of environmental principles, problems and their causes, and possible solution to those problems.

It must be pointed out that the environmental investigations contained in this publication by no means constitute a complete or finite environmental education program. These materials represent only one segment of the total environmental education program in the Kingsport City School System. For maximum effectiveness this material should undergo periodic evaluation and revision. Constant evaluation and suggestions for its improvement by all who use it will help in making this a useful tool for initiating and upgrading environmental education programs.

CONSULTANTS

The following people served in consulting or advisory capacities throughout the development of these materials:

Charles D. Carpenter
Director
Mobile Science Laboratory
School District No. 241
Albert Lea, Minnesota 56007

Dean Bennett
Project Director
Maine Environmental Education Project
Yarmouth, Maine 04096

Terry McCormick
Science Coordinator
Johnson City Schools
Binghamton, New York

H. C. Green
Work Conservationist
Sullivan County Soil Conservation Service
Blountville, Tennessee

Jonathan Wert
Environmental Education Specialist
Tennessee Valley Authority
Knoxville, Tennessee 37902

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Dalton Bloomer
Social Studies Teacher
John Sevier Junior High School
Kingsport, Tennessee

Don Little
Science Teacher
Ross N. Robinson Junior High School
Kingsport, Tennessee

David Ingram
Science Department Chairman
Dobyns-Bennett High School
Kingsport, Tennessee

Anna Dickison
Classroom Teacher
Lincoln Elementary School
Kingsport, Tennessee

Louise Hensley
Classroom Teacher
Johnson Elementary School
Kingsport, Tennessee

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Ronald B. Childress

Ronald B. Childress
Project Director

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BASIC RESOURCES

ENVIRONMENTAL INVESTIGATION: Factors Affecting Soil Temperature

Suggested Grade Level: Lower Elementary

Suggested Study Areas: School campus

Equipment: Pencils, trowel, thermometer

THEME: Many factors effect envirormental temperatures. Among these factors are exposure to sunlight, closeness to buildings, shade and weather.

Objective:

Demonstrate the variations in soil temperature.

Collect and interpret data.

Develop skills in using a thermometer.

PROCEDURE:

1. Demonstrate to the group how you would measure temperature in soil. Let them measure the temperature of the soil. (Caution: Thermometer is breakable. Bulb must be in ground.)

2. Use the trowel to make the hole to place thermometer. Let pupils use trowel for making holes to place thermometer.

3. Count slowly to 100 before reading results. Thermometer should be read in ground for best results.

4. Record the temperature at the site on the attached chart.

INTERPRETATION:

1. Which temperature is the greatest?

2. Did everyone get the same results?

3. What caused the temperature to not be the same?

Area	Temperature
In the Sun	
In the Shade	
Close to Building	

ENVIRONMENTAL INVESTIGATION: Variation in Water Temperature

Suggested Grade Level: Lower Elementary

Suggested Study Areas: Dickson School, Mad Branch, Bays Mountain

Equipment: Stream thermometer, data sheets, meter sticks

THEME: Living organisms are affected by varying water temperature.

Objectives:

Develop skills in using a stream thermometer and meter stick.

Determine variation in temperature at different depths and areas of a stream.

Develop an awareness of the effect of varying water temperature on life.

PROCEDURE:

Using the meter stick and stream thermometer, find the water temperature at various areas and depths in the stream.

Record the results on the attached data sheet.

DATA SHEET

Place in Stream	Depth	Water Temperature
Edge of Stream		
Near a Rock		
Middle of Stream		

INTERPRETATION:

1. Did you see any animals in the stream:

2. What are ways that varying water temperatures affect your use of water?

ENVIRONMENTAL INVESTIGATION: Introducing the Microscope

Suggested Grade Level: Upper Elementary

Suggested Study Areas: School Campus

Equipment: Microscopes, old magazines

THEME: Learning to observe is basic to all explorations.

Objectives:

To learn proper use and care of the compound microscope

To develop skills in observation

To develop an awareness of the value of the microscope to man

PROCEDURE:

The microscope is an expensive and delicate instrument. Carry the microscope with both hands, one under the base and the other on the arm. The purpose of the microscope is to magnify objects.
Using the accompanying illustration in identifying the parts of the microscope the students should label the parts of the microscope on the blanks provided. Proper use and care of the microscope should also be a goal during this period. Cut out a small "e" from magazine or newspaper print. Place the "e" right side up on a slide and place under the microscope. Students should independently use the worksheet accompanying this investigation.

Worksheet to Accompany Introduction of The Microscope

1. Make a drawing of the letter "e" in space "A" below as it appeared on the slide before you placed it under the microscope.

2. In space "B" below make a drawing of "e" as it appears under the microscope.

3. How is what you see through the miscrocope different from what you saw with your naked eye?_____

_____

4. While looking at your letter through the miscrocope move the slide to the left. In which direction does the letter seem to move?_____

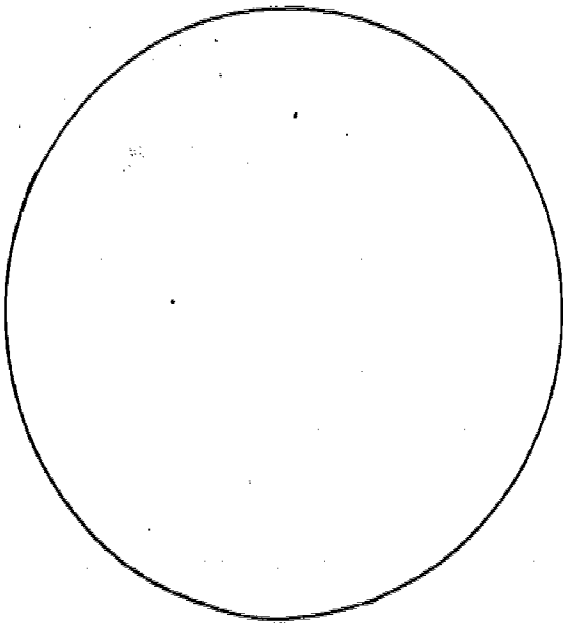
   Were you right?_____

5. Draw a circle on a piece of plain paper. Make the circle the size you think you can see through the microscope. Put the drawing under the microscope. Were you right?_____

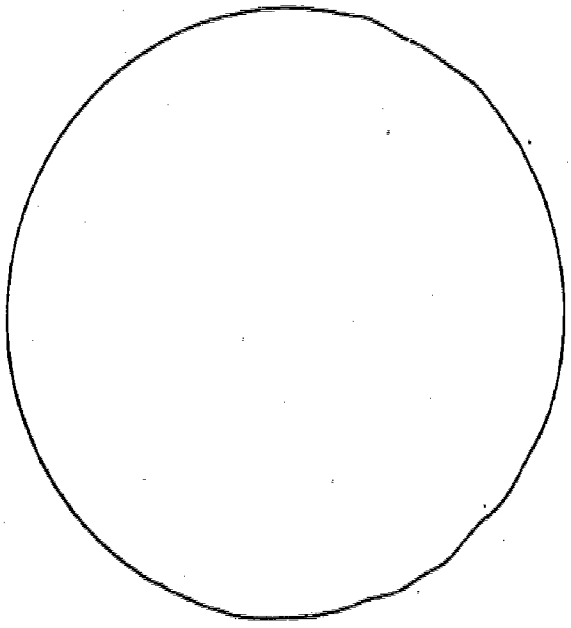
   Can you see the whole circle?_____

   If not, keep drawing circles until you get one the right size.

6. Look at other objects with your microscope.

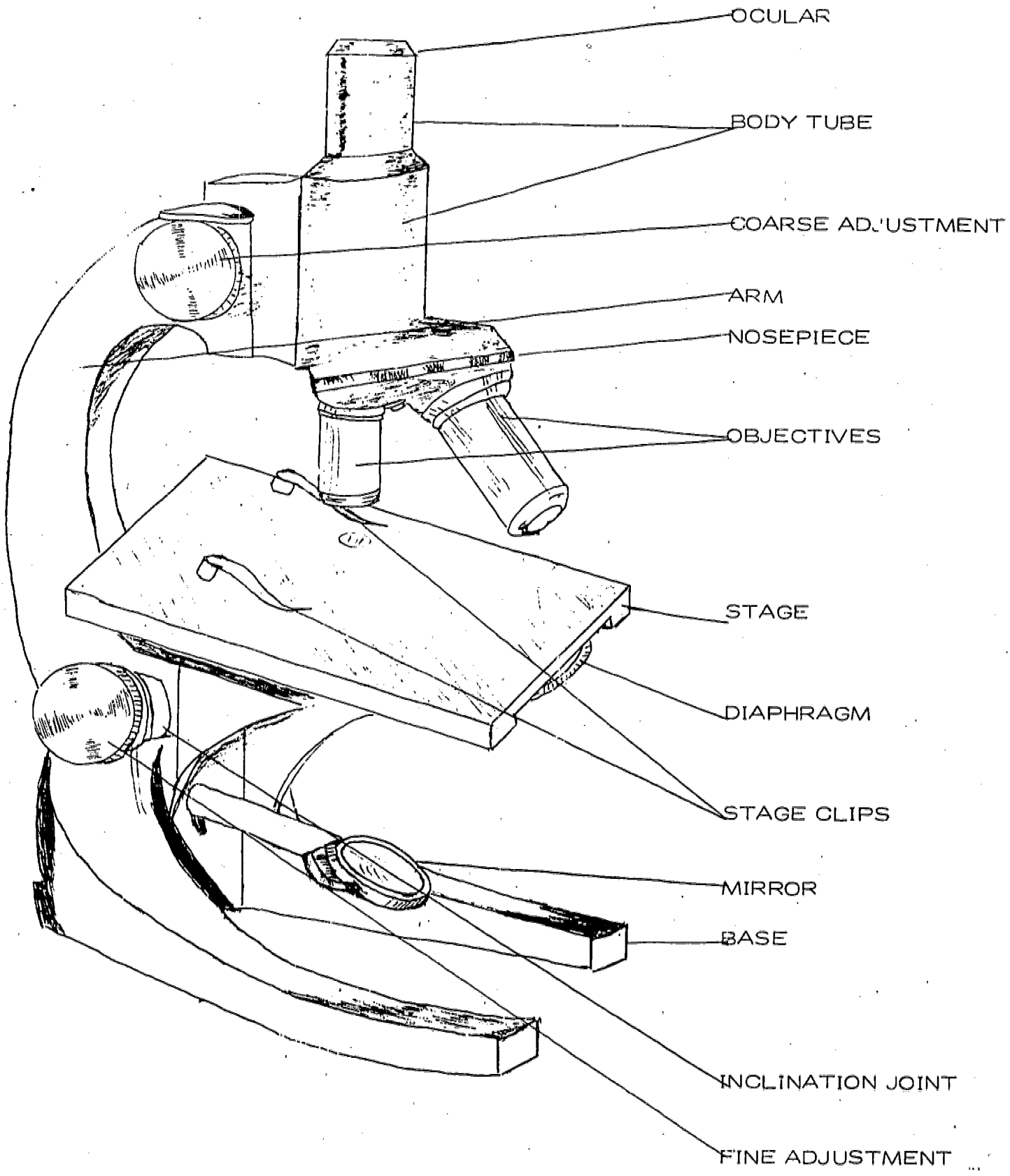


Space A



Space B

THE COMPOUND MICROSCOPE



ENVIRONMENTAL INVESTIGATION: Measuring Volume of Stream Flow

Suggested Grade Level: Upper Elementary

Suggested Study Areas: School campus or nearby stream

Equipment: Tape rule, long stick, stop watch, stick for floating

THEME: Man's use for and dependence on water.

Objectives:

To analyze continuity and change of stream flow.

To draw conclusions from the measurements of factors which effect volume of stream flow.

To develop an awareness of our daily consumption of water.

PROCEDURE:

With a tape rule measure 100 feet along the shore of a stream. Measure the distance across. With a long stick measure the depth at 3 different intervals across a bridge if possible. Use an average of the 3 different measures. Float a stick the measured 100 foot course. Time with a stop watch in seconds the required time for the stick to cross the 100 foot course.
Use this formula to determine the volume of stream flow in cubic feet:

$$\text{cubic feet per second} = \frac{\text{length X width X depth}}{\text{time}}$$

To convert the cubic feet to gallons, multiply cubic feet per second by 7.5.

Repeat this activity 3 times to see stream variance.

Students may find the average of the three measurements. Record the measurements on the data sheets and determine the volume of stream flow.

The average person uses about 200 gallons of water a day for home use. On the data sheet show how many people could live from water in this stream.

First Measurement Length	100 feet
Width	
Depth	
Floating time	
Cubic feet of water per second	

Second Measurement Length	100 feet
Width	
Depth	
Floating time	
Cubic feet of water per second	

Third Measurement Length	100 feet
Width	
Depth	
Floating time	
Cubic feet of water per second	

Formula for finding gallons of water measured in a second:

Cubic feet per second is equal to the length X width X depth divided by the seconds required.

To convert to gallons, multiply cubic feet per seconds by 7.5.

Average cubic feet of water per second from three measurements _____

Gallons of water per minute	X	1440 / No. minutes in a day	=	Total gallons water per day		200 gal. / Amount of water one person uses per day	=	Total No. people who could live from water in this stream

INTERPRETATION:

Was the flow the same at each measured time?

What environmental factors contributed to the difference in stream flow?

What is the importance of knowing how much water is flowing in a stream at various times?

What is one action we can take in everyday life to help improve the way water is managed in our homes? our community?

ENVIRONMENTAL INVESTIGATION: Soil Resources - A Guide to Land Use Planning

Suggested Grade Level: Secondary

Suggested Study Area: Any area within walking distance of school

Equipment: Soil science field testing kit, earth auger, field trowel, collecting spade, reference books on soils, soil sample boxes, soil thermometer, map of Kingsport or area to be studied, level

THEME: Identifying and interpreting major soil areas is a basis for guiding orderly growth and development in a community. The observable characteristics of color, texture, permeability, temperature, slope, and the acidity or alkalinity (pH) of soil are indications of some soil conditions important in land use planning.

Objectives:

To identify the major soil areas.

To determine if land (soil) is being used according to its recommended usage as determined by the Tennessee State Planning Commission and Sullivan County Regional Planning Commission.

To measure the: temperature, slope, pH of a soil and to determine soil color and texture.

PROCEDURE:

Background Information.

There are 8 classifications of land uses in Sullivan County. They are:

Residential - small lots with septic tanks (lots of less than one (1) acre).

Residential - small lots with central sewerage.

Residential - estate type, lots of more than one acre with septic tanks.

Industrial - included in this category are light manufacturing and other business enterprises such as large shopping centers, wholesale trade facilities and schools. Important soil properties considered are soil stability for foundations, suitability for grading, cutting and filling, topography, drainage and depth to bed rock.

Recreational - developed. Activities included in this category are community and school playgrounds, camp sites, picnic areas, golf courses, etc. Important soil properties considered are drainage, topography, productivity, and the ability of the area to support human and vehicular traffic.

Recreational - natural. This category includes hunting, fishing, hiking, nature study, primitive camping, etc.

Transportational - included in this category are roads, highways and airports. Important soil properties considered are soil stability, suitability for grading, cutting, and filling, topography, drainage and depth to rock.

Agricultural - this category includes the use of land for the production of cultivated crops and pasture. The chief soil properties considered are slope, erosion, drainage and productivity.

The soils of Sullivan County have been grouped into nine (9) major soil areas. Table I of Soil Resources Book, page 43, shows the limitation rating of each area for the various uses. Each of the nine soil areas are rated for each use as follows:

Very slight - few or no limitations.
Slight - minor limitations that can be easily overcome.
Moderate - moderate limitations that can be overcome with good planning and careful design.
Severe - major limitations which are difficult and costly to overcome.
Very severe - limitations generally prohibit use or make it unsound.

The following land features and soil characteristics are important in determining the suitability of soils for each of the defined uses.

Topography

Topography is the shape of the land surface. Topography features are major factors in determining land use limitations. The influence of topography is different for each land use. For example, most industrial commercial and residential developments require level or nearly level areas where cutting and filling is minimized. On the other hand large estate type residential developments and certain recreational uses are enhanced by rolling and hilly landscapes.

Drainage

Soil drainage refers to the rate at whcih water moves off the surface and through the soil to underground spaces. Soil properties affecting drainage include porosity, permeability, depth to the water table, seepage, slope, restrictive layers, etc.

Permeability

The rate at which water moves through the soil is called its premeability. This is influenced by the relative amount of gravel, sand, silt and clay in the soil. Some kinds of clay swell so much when wet that pores in the soil swell shut. This slows water movement and reduces the capacity of the soil to absorb more water. This is especially important in determining the soils suitability for filter fields.

Depth to Bedrock

Soil depth affects many uses. It is important in designing the kind and size of sewage disposal fields. It is equally significant in the underground installation of public utilities. Construction costs in building roads, foundations, and excavating basements are much higher in areas shallow to rock.

Productivity

Soils vary in their capacity to produce vegetation. Soil depth, drainage, moisture supply and fertility are some factors which influence productivity. Productivity is important in determining the capacity of the soil to support vegetation around the home; for recreation, wildlife, food and cover, roadbank stabilization, and of course, agriculture.

Select an appropriate area or areas in which to conduct these activities. The length of the activity may necessitate dividing the activity into two or more parts.

A. Color

Have students pick their own description of color.

Relationship of Color to Soil Conditions

Top Soil Condition	Dark (dark grey brown to black)	Moderately Dark (dark brown to yellow brown)	Light (Pale brown to yellow)
Amount of organic material	Excellent	Good	Low
Erosion factor	Low	Medium	High
Aeration	Excellent	Good	Low
Available Nitrogen	Excellent	Good	Low
Fertility	Excellent	Good	Low

Subsurface Soil Color (B Horizon)	Condition
Dull Grey (if in low rainfall soils)	Water-logged soils, poor aeration
Yellow, red-brown, black (if in forest soils)	Well drained soils
Mottled Grey (if in humid soils)	Somewhat poorly to poorly soils

1. What can you say about the following, based on the color of the top soil, or A Horizon?

   Amount of organic material_____

   Erosion factor_____

   Fertility_____

2. What can you say about the drainage in the B Horizon, based on color?

   _____

   _____

B. Texture (How the Soil Feels)

Texture is determined by feel (push and rub moistened sample between thumb and forefinger)

If it feels gritty.....sand
If it feels smooth and slick not very sticky.....silt
If it feels smooth, plastic, very sticky.....clay

What is the texture of your soil?_____

Texture	Water Holding Capacity	Looseness of Soil
Sand	Poor	Good
Silt	Good to excellent	Good
Clay	High (plants can't use it in clay)	Poor

My soil texture	Soil Water Holding Capactiy	Looseness
Topsoil (A)		
Subsoil (B)		

C. Permeability

The rate at which water moves through the soil is called its permeability. Take a soil sample and place it in a funnel which has had the bottom covered by guaze. Pour a measured amount of water into the funnel and use a stop watch to measure the amount of time required for the water to be absorbed by the soil.

Sample No.

	Soil (type or Color	Volume of H_2O	Time required for Permeability
1.			
2.			
3.			
4.			
5.			
6.			

D. Soil Temperature

Determine the temperature of the soil on the surface and 1 foot beneath the surface. Plant growth depends upon the temperature during the growing season.

Surface Temperature _____

Subsurface Temperature _____

Soil Temperature Chart

Soil Temperature	Conditions during growing season
Less than 40° F	No growth, soil bacteria and fungi not very active
40° F to 65° F	Some growth
65° F to 70° F	Fastest growth
70° F to 85° F	Some growth
Above 85° F	No growth

What does the soil temperature chart tell you about your soil sample's temperature?

_____

_____

F. Slope

Determining the slope of the land.

1. Select a place that represnets the average slope of the land being studied or take several measurements and average them.

2. Place one end of a 100 inch stick on the slope you want to measure. Hold out - right to be about level.

3. Place a level on the outright stick.

4. Measure the number of inches the free end of the stick is off the ground.

5. The number of inches is the slope of the land in percent. *

* if you use a different length stick, correct by using the following conversion table:

Conversion Table

Length of stick used	No. of inches the end of stick is above ground	Multiply by conversion factor	% Land
100"	_____	X 1	=
50"	_____	X 2	=
25"	_____	X 4	=

What is the slope of your land?_____%

Land Use Chart

This is a chart for soils in one kind of land, climate and plants. Other areas may require a different set of criteria.

Agriculture Uses	Slope	Erosion Hazard	Soil Depth	Drainage	Texture
Farm crops-cultivation good soil mngmt. practices	0-3	None	Deep	Well drained	Loam or silt loam
Farm crops-few to several special cultivation practices	3-20	Slight to moderate	Mod. deep	Somewhat poorly	Sandy loam or silty clay
Occasional cultivation many special practices	20-30	Severe	Shallow	Poor	Sand or clay
Pasture-woodland cultivation, no machinery can be used	0-2	None to slight	Deep	Well to poor	Stoney
Pasture, timber growing, woodland, wildlife, no cultivation machinery	30-90	Very severe	Deep to Shallow	Well to poor	Sandy, silty, claying or rocky
Wildlife, recreation	all	None to extreme	Deep to Shallow	Excessive to poor	Rockland, river wash, sand dunes

The most limiting soil factor will determine the best agricultural use of the land.

Occupancy land uses by man---

Man's valued uses of land has demanded criteria, in addition to agricultural uses, to determine proper management practices for living on the land. (Examples of others include: prescriptions for aesthetic management, soil site indexes for growing timber, criteria for greenbelts, etc.)

Some Uses & Factors Affecting That Use	Slight Limitation	Moderate Limitation	Severe Limitation
Roads and Streets			
Slopes	0-12%	12-30%	Over 30%
Depth	Over 40"	20-40"	Less than 20"
Waterable	Over 20"	10-20"	Less than 10"
Building Sites			
Slopes	0-12%	12-20%	Over 20%
Depth	Over 40"	20-40"	Less than 20"
Waterable	Over 30"	20-30"	Less than 20"
Septic Tank Filter Fields			
Slope	0-7%	7-12%	Over 12%
Depth	Over 6'	4-6'	Less than 4'
Waterable depth Below trench	Over 4'	2-4'	Less than 2'
Picnic and Camp areas			
Slope	0-7%	7-15%	Over 15%
Stones	0-29%	20-50%	Over 50%
Waterable during season of use	Over 30"	20-20"	Less than 20"

F. pH (Acidity or Alkalinity)

Determine and record the pH of your soil sample. Plants need many soil nutrients to grow well. The degree of pH affects how plants grow. The teacher should demonstrate how to use the pH kit. (Use just enough pH reagent to saturate soil sample. Match color at the edge of the soil sample with pH color chart.)

The pH scale runs from 1 to 14. 1 to 4.5 is too acid for most plants 6.5 to 7 - most plants do best here. 8.5 to 14 - too alkaline for most plants.

Example of plants in pH range:

pH 4.0 - 5.0 Rhododendrons, camellias, azeleas, blueberries, fern, spruce.

pH 5.0 - 6.0 Pines firs, holly, daphne, spruce, oaks, birch willow, rhododendron

pH 6.0 - 7.0 Maple, mountain ash, pansy, asters, peaches, carrots, lettuce, pines, firs

pH 7.0 - 8.0 Beech, mock orange asparagus, sagebrush

What was the pH of your soil sample?_____

Using the pH you recorded and the table, "Examples of Plants in pH Range," complete the following chart:

Some plants that could grow here based on the pH chart	Some plants actually observed growing here

INTERPRETATION:

Using the data from the 6 tasks and the land use chart, answer the following questions:

According to the agriculture and occupancy land use charts, this land could be used for:

Agricultural use:_____

(list and explain why)_____

_____

Occupancy: (yes or no and with what limitations)

Roads and streets _____

_____

Building sites _____

_____

Septic Tank Filter Fields _____

_____

Picnic and camp areas _____

_____

Based on your observations and the data you collected, do you feel this land is being properly used? _____

ENVIRONMENTAL INVESTIGATION: Characteristics and Properties of Soil - A Physical Factor in the Environment

Suggested Grade Level: Secondary

Suggested Study Area: Empty lot or open field around the school, Bays Mountain, Dickson School Nature Area, Roller Woods

Equipment: Graduated cylinders, stirring rod, water, soil test kit, thermometers, funnels, gauze, 250 ml beakers and funnels

THEME: Soils affect to a great extent the plant and animal life found in an area. Plants manufacture their own food but are dependent on the soil for water, minerals and support. Animals which use the area as a habitat derive their food from the plants or from other organisms dependent upon the plants.

Objectives:

To develop skills with various testing techniques.

To develop an awareness of effect the soils have on living organisms, including man.

To teach through practical work, various analytic techniques.

PROCEDURE:

A. Amount of air in the soil. Where spaces exist between particles of the soil, these spaces are usually filled with air or water. The size of the particles and compactness of the soil affect the spaces. When the soil holds large volumes of water it cannot hold large quantities of air. By adding a known volume of water to a known volume of soil and stirring thoroughly, we can displace the air contained in the soil and determine its volume. Collect small samples of soil from different places, such as a weedy region, swamp area and woods. Test the samples and record the results on the data sheet below:

Sample	Volume of Soil A	Volume of Water B	Total (A+B) C	Actual Volume D	Air Volume (C-D) E

B. Water retention of soils. Plants absorb retained water. The composition of soil may be rich in minerals and the rainfall sufficient, but may not be capable of supporting plant life due to the nature of the soil. Knowledge of the amount of rainfall the soil holds helps in crop selection, irrigation and improving crop yield.

Prepare three funnels with gauze taped or tied over the bottom. Then pack one with sandy soil, another with clay and the third with soil rich in humus. Now pour equal amounts of water into each funnel and watch the water run through the soil. Place graduated cylinders beneath the funnels and measure the amount of "runoff" water. Record your results in the chart as shown.

Soil	Volume of water poured in funnel	Volume of "runoff" water	Volume of water returned
Sandy			
Clay			
Humus			

1. Which soil permits water to run through most quickly?_____

2. Which soil retains the most water?_____

C. Testing the pH of soils. This test determines whether the soil is acid or alkaline. The term pH refers to the degree of acidity or alkalinity of a substance. It is usually expressed as a number from 0-14 which is the logarithm of the hydrogen ion concentration.

Collect small samples of soil from different places having different plant communities. By using the procedure outlined in the booklet accompanying the soil test kit, determine the pH of your soil samples.

Describe the plant community from which the soil came and record the pH in the form below.

Physical characteristics of plant community from which soil sample was obtained	Dominant Plant	pH

INTERPRETATION:

1. What kind of soil has the greatest water retention ability? What kind of soil has the least water retention ability? Compare the plant life found in these two types of soil.

2. How does the pH of the soil affect the type of plant community existing in different soil?

3. What changes in the kind of plant communities results when the minerals are constantly leached out of the soil?

4. To what extent has man's activities influenced the physical characteristics of the soils tested?

5. What effect will these characteristics and properties of soil have on industrial, residential and commercial development?

ENVIRONMENTAL INVESTIGATION: Influence of the Physical Environment on Geological Formation

Suggested Grade Level: Secondary

Suggested Study Area: Bays Mountain Geology Trail

Equipment: Magnifying glass, geology pick, cold chisel, shovel or trowel, bags, reference books and safety glasses

THEME: Rock types are keys to processes of geologic folding, pressing, faulting, erosion, melting and even volcanic activity which have taken place in your area. Since the conditions and processes which form different rocks are known, the identification of such rocks begins to reveal the geological history of the region going back millions of years.

Objectives:

To collect and identify different types of rocks.

To determine texture and mineral content of rocks.

To list those rocks useful to man.

To identify the environmental factors which have influenced the geology of the region.

PROCEDURE:

Background Information

Students should have an opportunity to identify rocks at school before going into the field. Provide a box of assorted, unlabeled rocks found in the area, rocks that they may handle, examine, and identify while referring to the rock charts included in this activity. These charts are based upon two most important and easily recognized properties by which rocks may be identified: texture and mineral content. Texture is determined by the size of mineral grains in the rock. Large grains or chunks represent coarse texture, small or indistinguishable grains, fine texture. Mineral content is determined by the identification of minerals which make up these grains or chunks. Color may vary from place to place and can only be a secondary property; but it may be helpful within the confines of a local area. Show examples of fine-and coarse-textured rocks so students may become familiar with these properties and train themselves to look for them. Classification will be on the basis of the three basic types of rock: (1) igneous (2) sedimentary (3) metamorphic.
Igneous Rocks Important Properties: texture and mineral content. Granite always contains three minerals: quartz, feldspar, and mica or hornblende. Pegmatite is often good source of crystals. Note that as rate of cooling becomes faster, texture becomes finer.
Sedimentary Rocks Important Properties: texture and content which may be stones or minerals. Metamorphic Rocks - Important Properties: texture, minerals, and cleavage.

Cleavage has to do with the ability to split the rock into layers. Slate and schist are both easily cleavable. The simple metamorphic rocks are usually harder and more compact due to slight melting and pressure than were their sedimentary ancestors and the pressures which they have undergone often form semiprecious minerals such as garnet, epidote, chlorite, and staurolite which are often found in these rocks. When a group goes out to collect rocks or minerals, it is important that there be sufficient equipment for everybody to do some digging, chopping, or chiseling at the same time. Don't dampen anyone's enthusiasm for geology by making him wait a long while for a tool.

INTERPRETATION:

1. What are the three basic types of rocks?

2. What was the most numerous type of rock in your collection?

3. What are the five most common rock-forming minerals?

4. Define cleavage?

5. What are some of the uses that man makes of rocks?

6. Of what value to man is the study of rock formation in urban and civil development?

7. Based on the results of your investigations, what environmental factors have influenced the geology of this region?

After all rocks have been collected, each student should attempt to identify each of their rock samples by completing the following chart. For assistance refer to tables 1, 2, and 3.

Identifying Rocks

	Name of Rock	Classification of Rock	Texture	Mineral Content	Economic Importance to man
Ex.	Sandstone	Sedimentary	Fine	Quartz	Jewelry/Electronics

Mineral	Chemical Components	Colors	Hardness	Properties & Uses
		A. Non-Metallic Luster		
Quartz	SiO_2	Colorless, Rose, Smoky, Milky, Amethyst(Violet)+	7	Glassy. Used in Jewelry & Electronics
Feldspar	$NaAlsi_3O_8$ +	White, Buff, Pink, Gray	6	Blocky. Used in soap Powder & Porcelain
Mica	ALSiO ++	Transparent, Gray, Black (Purple called Lepidolite)	2.5	Electrical Insulators
Hornblende	CaNaA^{1}SiO +	Black	5.5	Coal-Like Appearance
Calcite	$CaCO_3$	Transparent, White, Gray, Gold +	3	Fizzes in Acid. Mineral in Limestone & Marble
Halite	NaCl	Colorless, White	2.5	Rock salt. Cubic. Glassy
Garnet	FeAlSiO +	Red, Brown, Yellow, Green	7	Tiny Barrels, Glassy
Fluorite	CaF_2	Clear, Blue, Green, White + +	4	Glassy
Gypsum	$CaSO_4 \cdot 2H_2O$	Gray, White, Colorless	2	Plaster
Tourmaline	AlSiO ++	Black, Pink, Green +	7	Jewelry
		B. Metallic Luster		
Magnetite	FE_3O_4	Gray - Black	6	Remove from soil and sand with magnet. Iron Ore
Pyrite	FES_2	Pale Brass Yellow	6.5	Fool's Gold. Source of Sulfur

Mineral chart. First five are the most common rock-forming minerals

Rock	Texture	Colors	Mineral Content	Rate of Cooling	Descriptive Notes
A. Individual Grains, Crystals or Fragments Visible					
Breccia	Coarse	Green-Gray + +	Feldspar, Quartz + +	Sedimentary Igneous	Solid rock in throat of volcano broken into small pieces and thrown from volcano by eruption. Cemented together by volcanic dust and ash.
Pegmatite		Light	Feldspar, Mica Quartz	Very slow	Very large crystals from 1" to many feet
Granite		Pink, Buff, Gray + +	Feldspar & Quartz Mica or Hornblende	Slow	All mineral crystals about same size
Trap		Green-Gray	Feldspar-Olivine +	Medium	General name..may be applied to all dense dark igneous rocks
B. Individual Grains Not Visible					
Basalt		Black Dark Green	Feldspar, Olivine +	Fast	Solidified lava - found in dikes, sills and other intrusions
Pumice		Buff-Gray	Glass	Very Fast	Solid ash-like lava contains trapped volcanic gas. Floats in water
Obsidian	Fine	Red-Black	Glass	Very Fast	"Natural Glass" - Lava which cooled so fast that no crystals were able to form
Porphrytic		Adjective used to describe special condition found in above rocks.		Scattered large crystals against a background of smaller crystals. Porphrytic Granite, Basalt, Etc.	

Igneous Rock Chart

Rock	Texture	Hardness	Content	How Formed	Notes
Conglomerate	Coarse	Hard	Rounded Pebble-Like Stones. Muck Quartzite and Feldspar	Stones carried by rivers and deposited in mud	Also called "Puddingstone". Held together by brownish muds of sand or clay.
Tillite			Both sharp and rounded stones of all sizes. Much quartzite	Stones carried by Glacier & dropped upon melting of the ice	Held together by a coarse mud cement. Larger boulders may show glacial scratches
Sandstone			Quartz Grains	Sand carried by rivers & deposited	Coarse or fine sand cemented together. Surface like sandpaper
Limestone			Calcite	Built up in shallow seas from skeletons of tiny animals	Tan to gray. Fizzes in acid. May contain fossils
Shale	Fine	Soft	Clay, Mud & Silt	Fine mud & silt carried by rivers & deposited	Can be split into layers. Often has alternating dark & light layers. Sandstone deposited in summer, shale in winter

Sedimentary Rock Chart

Rock	Rock Formed From	Minerals	Colors	Notes
A. Simple Metamorphic Rocks - Direct Change of Sedimentary Rocks - One Basic Mineral				
Quartzite	Sandstone	Quartz	Pale Whitish shades	More compact than sandstone - Crystalline- One of the hardest rocks
Marble	Limestone	Calcite	White, pink Gray, Black + +	Fizzes in acid. Crystalline. May have intermixed colored Bands
Slate	Shale	Clay	Red, Gray, Green, Black + +	Splits into layers. May be tiny mica flakes visible. Used for flagstones.
B. Complex Metamorphic Rocks - Greatly Changed, New Minerals Formed - Many minerals				
Phyllite	Shale Granite ++	Feldspar Quartz Mica + Chlorite +	Variable	Fine texture. Silky luster irregular layers
Schist	Slate Felsite Granite +	Mica Garnet Hornblende +	Dark Variable	Thick layers. Flakes of Mica come off on hands
Gneiss	Shale Granite Conglomerate +	Garnet Feldspar Quartz Hornblende Mica +	Variable	Irregular Bands. Medium to Coarse texture.

Metamorphic Rock Chart

ENVIRONMENTAL PROBLEMS

ENVIRONMENTAL INVESTIGATION: Water Quality Criteria

Suggested Grade Level: Upper Elementary

Suggested Study Areas: School campus, Dickson School Nature Park, Mad Branch or Garden Drive, Reedy Creek

Equipment: Screens, jelly cups, large pan or container, Golden Nature Guide Pond Life Books

THEME: Water is essential for all life, and its state affects the amount of life it can sustain in one place.

Objectives: To analyze a stream to determine the effect of water temperature, air temperature, and pH on the variety and quantity of existing life.

To generalize from the data collected. Man's role in the quality and use of this stream.

PROCEDURE:

A. Using the equipment supplied, investigate the stream to see what animals you can find. Record your findings in the chart below.

Description of Where Found	Type (Name or Sketch)	No.

Return animals to water as soon as finished.

B. Based on the aquatic animals you found, and the charts below, predict the following characteristics of this stream:

I predict:

the water temperature will be_____because_____
the air temperature will be _____because_____
the pH number will be_____becuase_____

Keep these predictions for your own reference.

Temperature		Examples of Life
Greater than 68° (warm water)		Much plant life, many fish diseases. Most bass, crappie, bluegill, carp, Catfish, caddis fly.
Less than 68° (cold water)	Upper Range	Some plant life, some fish diseases. Salmon, trout, stonefly, mayfly, caddis fly, water beetles, striders.
	Lower Range (less than 55)	Trout, caddis fly, stonefly, mayfly.

Analyzing Data

pH RANGES THAT SUPPORT AQUATIC LIFE

MOST ACID NEUTRAL MOST ALKALINE

1 2 3 4 5 6 7 8 9 10 11 12 13 14

Bacteria 1.0_____13.0
Plants (algae, rooted, etc.)6.5_____12.0
Carp, suckers, catfish, some insects 6.0_____9.0
Bass, crappie 6.5_____8.5
Snails, clams, mussels 7.0_____9.0
Largest variety of animals (trout, amyfly, stonefly, caddis fly) 6.5_7.5

C. After making your predictions, measure the water temperature, air temperature, and pH and compare these results with your predictions.

	Prediction	Actual Test	Difference
Water Temperature			
Air Temperature			
pH			

INTERPRETATION:

1. Where did you find most of the animals?

2. What similarities are there among the animals?

3. What classification system could we use to classify the aquatic animals we found?

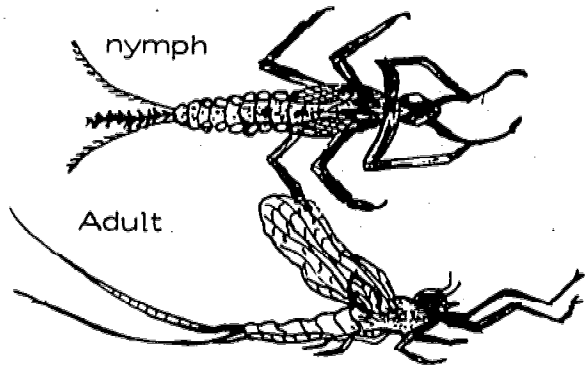
4. What other life would you expect to find in this stream?

5. Would we be likely to find the same animals in a different aquatic environment?

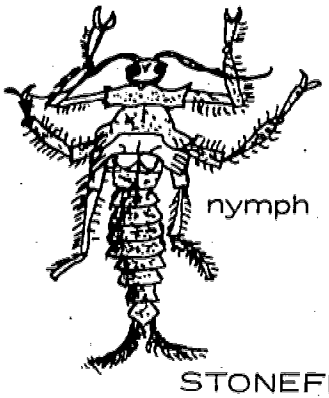
6. Based on your predictions and investigations what role has man played in determining the variety and quantity of life in this stream?

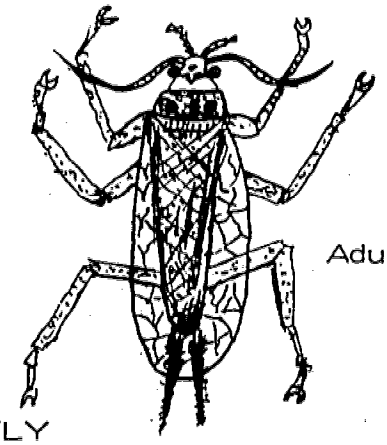
7. What action would you suggest to improve the quality of this stream?

AQUATIC INSECTS

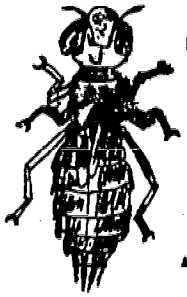


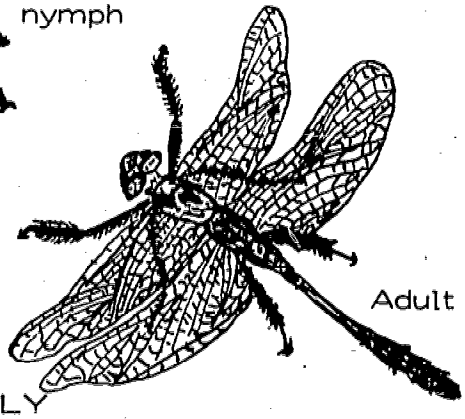
MAYFLY





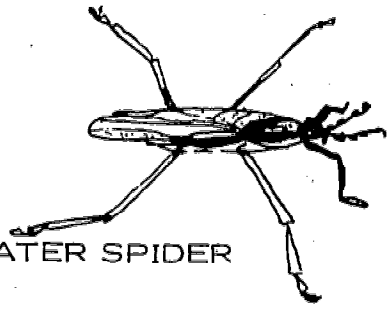
STONEFLY



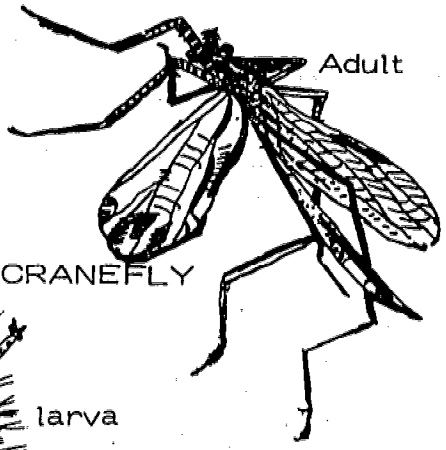


DRAGONFLY

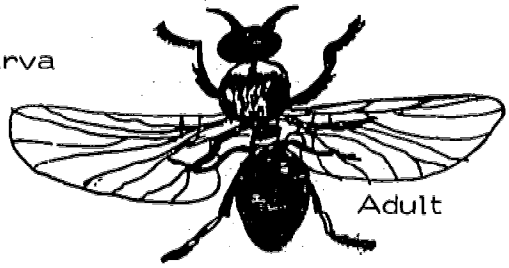
WHIRLIGIG BEETLE



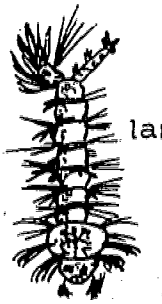
WATER SPIDER

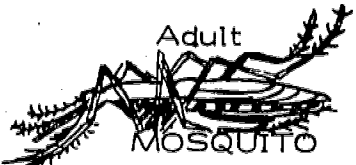


CRANEFLY

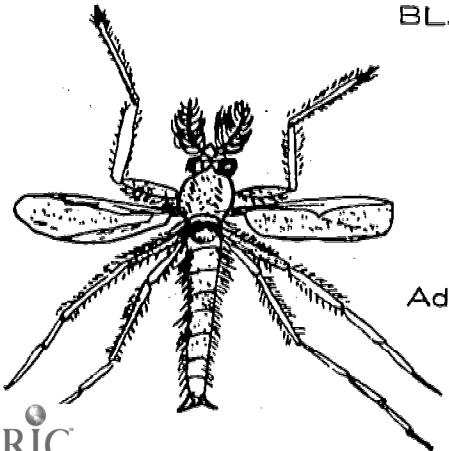


BLACK FLY

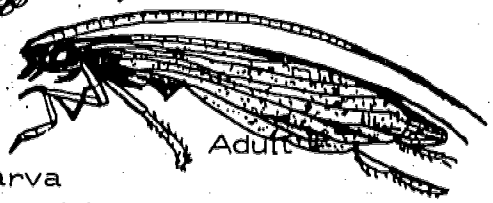


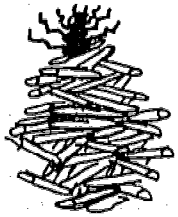


MOSQUITO



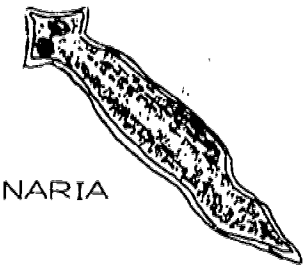
MIDGE





CADDISFLY

SUB-SURFACE FRESH WATER ORGANISMS



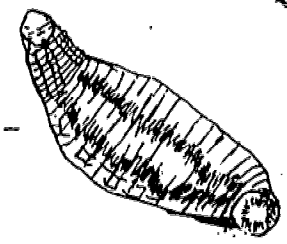
PLANARIA

BRYOZOAN COLONY

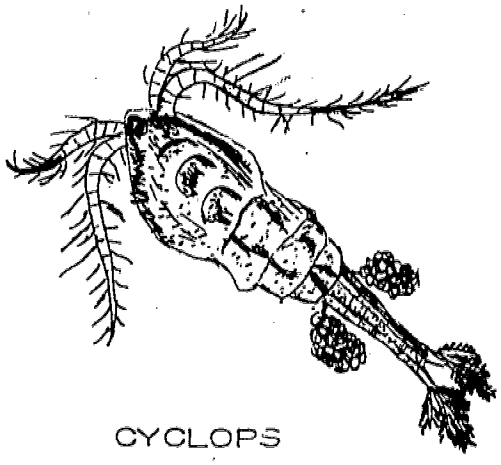
– Top

Mouth –

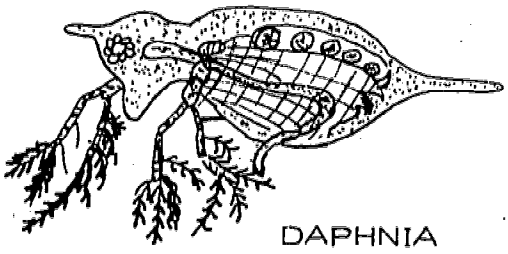
Bottom –



LEECH

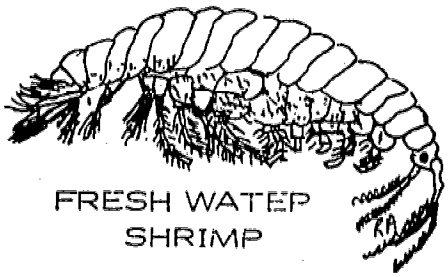


CYCLOPS



DAPHNIA

FAIRY SHRIMP



FRESH WATEP SHRIMP

ENVIRONMENTAL INVESTIGATION: Sound and Noise

Suggested Grade Level: Upper Elementary

Suggested Study Area: School campus

Equipment: Tape recorder, data sheets, or sound level meter

THEME: Man is dependent upon a high quality environment to meet his mental and physical needs, including those needs to control sound.

Objectives:

Implement the tape recorder or sound level meter in evaluating sound sources according to noise intensities.

To determine sound intensities at various times of the day at specific locations.

To analyze what effects a change in function has on the sound level in a location.

Formulate a hypothesis as to the effect of noise on the human environment.

PROCEDURE:

Using a tape recorder make recordings at the specified locations on the school site as designated on the data sheet. Indicate what time of day the recordings were made. Identify each location by speaking the identity into the microphone. Get at least two recordings for each location. Setting the tape recorder at the same level (usually on full) and the same playback level (usually whatever is comfortable to listen to) will give a relative comparison between sound intensities. Rank and record on data sheet I the compared intensities from least to most intense and give a numerical value from 1-10 to make a convenient and meaningful comparison. Remember that the record level is on full and the microphone should not be put close to the speaker's mouth. On data sheet 2 evaluate and record those sound sources as to sound and noise.
On data sheet 3, identify those sound sources heard at morning, noon and afternoon to determine how a change of function in a location can affect the sound level.

SOUND AND NOISE INTENSITY
DATA SHEET #1

Quiest Sound = 1

Loudest Sound = 10

Location	Morning	Noon	Afternoon	Evening
School:				
Classroom				
School Office				
Front Street				
Hall				
Bathrooms				
Band Room				
Library				
Shop				
Cafeteria				
Auditorium				
Gym				
Playground				

SOUND AND NOISE
DATA SHEET #2

Quality	
Sound	Noise

ve off the chart those sound sources about which you can't decide.

SOUND AND NOISE
DATA SHEET #3

FUNCTION

Location _____

Morning — Sounds you can identify in the recordings:

1.

2.

3.

Noon — Sounds you can identify in the recording:

1.

2.

3.

Afternoon — Sounds you can identify in the recording:

1.

2.

3.

INTERPRETATION:

In which locations were sounds more intensified?

In which locations were sounds least intensified?

During what times of the day could more sounds be identified?

What effect does a change in function have on the sound level in a location?

Using the results of your investigations, predict some of the effects noise has on man.

ENVIRONMENTAL INVESTIGATION: Effect of Man on Water Quality

Suggested Grade Level: Upper Elementary

Suggested Study Areas: School campus, Dickson School Nature Park, Mad Branch, Reedy Creek

Equipment: Water pollution kit "A" in Mobile Laboratory, water samplings from school drinking fountain, home, local ponds, and nearby streams

THEME: Water is essential for life, and its state affects the amount of life it can sustain in one place.

Objectives:

Use water testing equipment to compare various samplings of water for pollutants.

To determine water sources with more pollutants and to find which pollutants are more abundant.

To develop attitudes of awareness concerning the effect of water quality on all life, especially man.

To motivate students to work toward solutions to water quality problems.

PROCEDURE:

Obtain the water test kit. Collect water samples from the school drinking fountain, home, local ponds and nearby streams. Test each sample for pollutants. Use the student Data Sheet for making and recording comparisons of the various samplings.

INTERPRETATION:

1. Which sample contained the most pollutants?_____

2. What reasons can you give for this?_____

_____

3. Which pollutant was most abundant?_____

In which water sample was it found?_____

What reasons can you give for this?_____

4. Which pollutant was less abundant?_____

In which sample of water was it?_____

What reasons can you give for this?_____

5. Was the drinking water polluted?_____

6. What could have caused it to have been polluted?_____

7. How does increasing population in your area affect the water supply (beyond reducing the amount available per person)?

8. What factors will determine the amount of water used in the future? How can we assure a quality water supply for future generations? What factors contribute to the spread of water pollution?

DATA SHEET

	Drinking Fountain	Home Pond or Stream	Miscellaneous
Nitrate			
Phosphate			
Carbon Dioxide			
Ammonia Sulfide			
Silica			
Hardness			
Turbidity			

Suggested Grade Level: Upper Elementary

Suggested Study Areas: School campus, Dickson School Nature Park, Bays Mountain, Allandale Farm

Equipment: Filter paper, balance or laboratory scales, glass jars, distilled water, magnifying glass, tape and thumb tacks, pH tester, litmus paper, petri dishes

THEME: Man is dependent upon a high quality environment to meet his mental and physical needs.

Objectives:

To investigate and anlayze particulate matter in the atmosphere.

To identify sources of excessive particulate matter found in the air.

To develop an awareness that indiscriminate pollution of the air is one of the most pressing environmental deterioration problems facing man today.

PROCEDURE:

Background Information:

Solid particles of such things as soot, dust, and pollen are sometimes suspended in the air we breathe. They come from fuel combustion, construction projects, and harvesting operations, plus a host of other manmade and natural sources. Eventually these particles are inhaled by men and animals, fall into water supplies, or settle on surfaces as dust or sometimes thick grime. Some kinds of these particles, or particulates, can make men and animals sick. Some foul water supplies, and others blacken buildings and coat windows with sludge.

A. Coat the filter paper with petroleum jelly and put the filter on a paper plate, then record the weight of each piece of filter paper and plate you plan to use.

Select one or more exposure sites for the filter paper; any place where dust collects will do.

Weigh any tape used to secure the filter paper at the exposure site. After three to seven days weigh the filter paper again. Note any increase in weight or change in color of paper. Use data sheet to record the information.

B. Use the magnifying glass to note the different sizes, colors, and shapes of particles collected on the filter paper. Put some distilled water in a jar. Test the pH of the water and save the litmus paper. Rinse the particles off the filter paper into the jar and observe the particles with a magnifying glass. Test the pH of the water with the particles suspended in the water. Compare the litmus paper to that used to test the distilled water. Save both litmus papers.

Optional Activities:

1. Obtain a sample of particulate from a source such as an air conditioner or furnace filter. Rinse the particles into another jar of distilled water. Observe what happens to the particles. Check the pH, and compare the litmus paper.

2. Expose a plant to the carbon monoxide from an automobile to observe the effects. Do the same with an insect.

3. Collect and weigh the particles emitted by the exhaust of an automobile.

4. Collect and melt snow during appropriate season. Test the melted water with pH or litmus paper. Observe if chemical pollution in the air has changed the basic nature of water. Observe the particles in water left from the melted snow.

DATA SHEET

	pH	Observations
Distilled Water		
Distilled Water with Pollution		
Distilled Water and Air Condition Particles		

Starting Weight of Filter Paper	Weight at End of Experiment	Amount of Particulate Matter Accumulated	Possible Source
Site 1			
Site 2			
Site 3			
Site 4			

INTERPRETATION:

1. Plot and graph comparing the amount of particulate matter accumulated for each of the four sites.

2. After identifying possible sources of particulate matter, form hypothesis, identifying possible solutions to these problems.

ENVIRONMENTAL INVESTIGATION: Decomposition and Recycling

Suggested Grade Level: Upper Elementary

Suggested Study Areas: Dickson Elementary School, Roller Woods

Equipment: Hand lens, insect preserving equipment, equipment to trim or peel bark from trees, data sheets

THEME: Man would do well to observe nature's example of continuous recycling and recycle the results of his technology.

Objectives:

Irvestigate the three states of decomposition in a rotting log: (a) standing dead tree, (b) newly fallen tree, (c) log rotting inside.

Observe in each of the three states of decomposition.

Investigate factors involved in which a log disintegrates and decays until it becomes a part of top soil.

Develop an awareness of man's need to recycle the results of his technology.

PROCEDURE:

Use the data sheet to record informtion while studying each stage of decomposition. Students may forget many of the things they uncover if not filled in while they work.

Stage 1. Standing Dead Tree
If you see a tree that has fungi or holes in it and the bark is peeling, it is probably dead even though it may be still standing.
Rain collects in holes in the trees.
Insects chew, making more holes. Animals such as woodpeckers, squirrels, and beetles make holes and trails. Loose or torn bark may be present.

Stage 2. Newly Fallen Tree
Is there any bark on the tree? Is the wood form or soft, wet or dry? What bugs are found in it or on the wood? Are there any tunnels (an axe may be helpful here to peel off bark and observe deep tunnels in the wood). Record all information on the Data Sheet. Plants and animals that inhabit the fallen tree change the wood physically and chemically.

Stage 3. Log Rotting Inside
Lift off the outer shell of the log and examine the contents. Break apart the shell, being careful to note all animals. Rake through the rotten part of the log being watchful for lizards, snakes, salamanders, and bugs. Record all types and their numbers. Are they any "mouse size" animals running in or under the log? What animals and plants on the inside may be soft and spongy while the outer shell remains firm?

Finally the log will desintegrate and become a part of the debris over the soil. In time decay will continue and this log will be a part of the humus layer and then a part of the top soil.

INTERPRETATION:

1. In what stages of decomposition did you find the most organism?

2. Illustrate with a diagram the cycle that is taking place in these 3 stages of decomposition?

3. Compare man's need to recycle with natural recycling.

4. How did American's in Colonial times dispose of their waste? Could we use these methods today?

Optional Activity

Investigate ways of preparing a compost heap.

Data Sheet for Stage 1 - Standing Dead Tree

A dead tree may have lichens, fungi, peeling parts and it may have holes. A tree is killed by the activities of the insects, animals and bacteria that have been hosted by the tree.

Rotting Log Data Sheet
Plants, Animals, Fungus

Date_____

Stage 1 Standing Dead Tree

Condition of Tree:

Number	Name or Draw and Describe plants, animals and fungus

Data Sheet on Stage 2. Newly Fallen Tree

Is there any bark on tree? Is the wood firm, soft, wet or dry? What bugs are found in or on the wood? Are there any tunnels?

Rotten Log Data Sheet
Plants, Animals, Fungus

Date_____

Stage 2. Newly Fallen Tree

Condition of tree:

Number	Name or Draw and Describe plants, fungus and animals

Data Sheet for Stage 3, Log Rotting Inside

Lift off the outer shell and examine the contents. Note all animals. Watch for lizards, snakes and salamanders, as well as bugs. The inside may be soft and spongy while the outer shell remains firm. Finally the log will disintegrate and become a part of the debris over the soil. In time decay will continue and this log will be a part of the humus layer and then part of the top soil.

Rotting Log Data Sheet
Stage 3 - Log Rotting Inside
Plants, Animals, Fungus

Date_____

Condition of tree:

Number	Name or Draw and Describe plants, animals and fungus

ENVIRONMENTAL INVESTIGATION: Physical, Chemical And Biological Characteristics of an Aquatic Environment

Suggested Grade Level: Secondary

Suggested Study Area: Dickson Nature Park, Roller Woods, Bays Mountain

Equipment: Meter or yard stick, thermometer, tin can, pH paper, phenolphthalein solution, sodium hydroxide solution, maganese sulfate, 100 ml flask, potassium hydroxide, potassium iodide, cork stoppers, dilute sulfuric acid, sodium thiosulfate, eye dropper, microscope, plankton net

THEME: A dynamic biotic community is dependent upon the intergration of the physical, chemical, and biological environmental factors.

Objectives:

To determine the importance of any biotic community and how it relates to our own community.

To demonstrate that plants and animals within a given community are inter-dependent.

To develop the concept that environmental conditions on land vary to a greater degree than they do in water.

PROCEDURE:

A. Select a small pond or a fresh-water stream located near your school. Over a period of 2 weeks to one month examine the physical features of your selected biotic community and record the following data in your notebook or a data sheet provided by your teacher.
   1. How big is the pond or how wide is the stream?
   2. What is the average depth?
   3. Is it sheltered by trees?
   4. Does the sun shine on any portion of your community?
   5. Make a list of the living things you observe in either community. Example might include: lillies, dwarf beetles, duckweed, mites, water striders, mosquito larva, frog eggs, salamanders, crayfish, minnows, fish, snakes, algae, caddis flies, dragon fly larva, cattails, ducks
   6. Is there a variety of plants and animals?
   7. How many animal populations are represented?
   8. What plants do you find growing on the bank of the pond or stream? What plants are found growing on rocks?
   9. Do any of the plants grow in the water?

B. 1. On your data sheet, keep a record of the plant and animal relationships that you observe. Is there any evidence that the plants help the animals? In what way do the animals help the plants? What kind of relationship is this called? Are there any changes in either plant or animal life from week to week? Can you observe the growth and development of living things in either community?
   2. Compare your list of observations with your classmates.

C. In completing your investigations of the pond or stream community, there are several questions that you should attempt to answer.

1. Is there a relationship between the living and nonliving things in your community?
2. What is the food chain in either or both communities?
3. Can this food chain be traced?
4. Is your selected biotic community polluted or becoming polluted? What are the causes?
5. What changes are taking place in the pond or stream?
6. Do you believe plant and animal life can become adapted better to a pond or stream?
7. What factors are involved in becoming adapted to a certain community?
8. Could fresh water trout survive in a pond?
9. Could a pond lily survive in a fresh water stream?
10. From your observations, what does the location and the amount of sunlight have to do with the population growth in either community?

D. 1. Mapping

Draw an outline map of the pond or stream. Show the scale of your map and indicate which way is north. Include both natural and manmade features in your map. Label trees, islands, dams, piers, swampy ground, roads, hillsides and buildings. Construct your map as detailed as possible.

2. Water Depth

Carefully measure the water depth at various places. Keep a record of the measurements. You might use a long pole and weighted string to obtain various depth measurements.

3. Temperature

Using a thermometer, make a detailed record of both the air temperature and the water temperature of your community. Keep in mind that the sun affects the water temperature in shallow and deep parts.

4. Clearness

On your data sheet, record the clearness of the water. Is it clear or murky? How far does the light penetrate the water? At what depth can you no longer see?

E. Chemical Characteristics

1. Testing the pH of the Water

Is the water neutral, slightly acid, or slightly alkaline? Using the pH paper, compare the color of the pH paper with the colors on the chart provided with the pH paper kit. How does the pH of the water affect plant and animal life in a water community?

2. Carbon Dioxide Content.

Carefully add 10 drops of phenolphthalein solution to 100 ml of pond water. Slowly add some sodium hydroxide solution with an eyedropper. Add the sodium hydroxide one drop at a time. Stir thoroughly after adding each drop. Continue adding sodium hydroxide until a permanent pink color develops. Use the following formula to determine the carbon dioxide content of the pond or stream water:

Number of drops of Sodium hydroxide X 140 = amount of CO_2 in water in parts per million

3. Oxygen Content.

After immediately getting a sample of water from your biotic community, add 1 ml of manganese sulfate to a flask or bottle containing 100 ml of fresh pond or stream water. Then add 1 ml of potassium hydroxide-potassium iodide. Stopper the flask and mix thoroughly. Then add 1 ml of dilute sulfuric acid. Put the stopper back in the flask and mix the solution again. Let the water stand for 10 minutes. After this time, add sodium thiosulfate to the water with an eye dropper. Count each drop that you add. Continue until a permanent color change appears. Determine the oxygen in the pond or stream by using the following formula.

number of drops of thiosulfate X 28 = amount of oxygen in water in parts per million

F. Biological Characteristics.

1. Shore-Line or Bank Vegetation.

What kind of plants grow along the banks. Reeds? Long grasses? Cattails? Describe and identify, if possible, the different plants that grow along the bank or shore. Can you explain why some plants grow there and other do not?

2. Aquatic Vegetation.

What kinds of plants are growing in the pond water? Do any of these resemble aquarium plants? Are there water lillies? Do the aquatic plants grow in shallow or deep water?

3. Plankton.

All microscopic life swimming or drifting in the pond or stream can be termed plankton.

Make a plankton tow net to obtain samples. Remove the cover and the bottom from a coffee can. Tie an old nylon stocking around the can. Cut a hole in the toe of the stocking and tie a small empty bottle to it. An old spice bottle will work well. Punch three holes around the edge of the coffee can for your tow line. Tow the plankton net from one end of your area to the other. Examine the plankton under a microscope provided by your mobile laboratory. What kind of organisms do you find? Are there more of these organisms of certain depths? How does this affect the aquatic community?

INTERPRETATION:

1. Are there any similarities or differences between a pond community and a fresh-water stream community?

2. Compare these communities with your own community?

3. Could human beings exist if there were no other animals or plants ? Explain.

Data Sheet Analysis - Physical Characteristics

Location of Pond or Stream	Estimate Size of Pond or Stream	Average Depth	Type of Vegetation Trees, Shrubs, etc.	Kind of Animal Life	Number of different animal populations	Number of different plant populations

Data Sheet Analysis - Plant and Animal Relationships

Kind of Animal	Kind of Plant	Change in plant or animal life Change or none	Growth Development Pos. or Neg.

Data Sheet Analysis

Sketch or description of food chain	Condition of habitat-- polluted or non-polluted	Factors involved in plant or animal adaptation to their habitat	Effect of location and sunlight on habitat--		
			Good	Bad	No Effect

Data Sheet Analysis
Chemical Characteristics
Biological

pH of Water	Carbon Dioxide Content	Oxygen Content	Aquatic Vegetation	Type of Microscoptic Organism

Data Sheet Analysis

Brief Sketch or Map Diagram Showing Habitat location	Water Depth Measurements Average	Temperature		Clearness of water		
		Air	Water	Clear	Murky	Other

ENVIRONMENTAL INVESTIGATION: Ecological Study of a Local Water System

Suggested Grade Level: Secondary

Suggested Study Area: Holston River from Hammond Bridge to below the city sewage treatment plant. A designated section of Reedy Creek or other nearby stream.

Equipment: Water sampling and measurement kit, maps of river or stream, data sheets.

THEME: Water is a basic natural resource and must be maintained in a clean state for maximum usefulness.

Background Information:

Water covers about 71% of the earth's surface. It is an essential for all forms of life. All water in nature is less than 100% pure. The wastes from organisms are always present. A waterway becomes polluted when the load of wastes becomes too heavy for the river or stream to purify itself. Overloading of a waterway's self-cleaning capacity can result from both natural and manmade causes. However, important to any understanding of this subject is the knowledge of exactly what causes water pollution, its effect on a particular waterway and the various contributing factors that must be taken into consideration.

Objectives:

To use various methods for detecting environmental differences, or possibly, pollution.

To determine or observe some characteristics of a local water system.

To show that interrelationships exist between parts of our environment and that changes in any part affects the other parts.

PROCEDURE:

A. Determination of Test Sites, Procedures and Prepartion of a Map of the Test Area.

Establish a minimum of five testing points on each side of the river or stream. The easiest method is to prepare a map of the area to be studied. Community maps from telephone books, city hall, or gas stations may be used in preparing your map. After your map is completed mark your test sites on the map. Provide adequate space on the map for recording all test results. A large map of the test area might look like this: (See attached sheet) The important part of testing on either a river or stream is to decide on a uniform way to make the test. If sampling is done haphazardly the results may be meaningless. Careful sampling at pre-determined sites will provide enough information to discover basic patterns and to form some conclusions. Sampling can be as extensive as resources and student interest permit.

B. Determining Dissolved Oxygen Concentration.

Oxygen is an important atmospheric gas in water. Oxygen enters water from the atmosphere and from photosynthetic plants. It leaves water by dispersion to the air, absorption by organisms through respiration, and by decomposition and chemical changes of organic and inorganic wastes. When oxygen is completely exhausted in organisms that depend upon dissolved oxygen will die off and disappear. The disappearance of oxygen produces striking fish mortality. Other small organisms, not so noticeable, may also be wiped out.
Using the water sampling bottle in the mobile lab obtain a sample of water from a predetermined depth and at a predetermined distance from the bank. A uniform method of obtaining the samples should be established and followed at all test sites. Remove the "fixed" sample for testing from the removable collecting chamber of the water sampling bottle. Follow the directions in the water test kit for the determination of dissolved oxygen. Record your results on the data sheet.

C. Determination of Free CO_2 Concentration.

Free and available carbon dioxide is tremendously important to life. Aquatic plant life, plankton as well as large rooted plants, depends on carbon dioxide for growth and photosynthesis of new plant materials. One end-product of photosynthesis is oxygen which is a requirement for aquatic animals. These animals return carbon dioxide to the water as an end-product of respiration. When oxygen concentrations drop in waters containing organic wastes, the carbon dioxide concentrations rise. The rise in CO_2 makes it more difficult for fish to use the limited oxygen supply. To take on fresh oxygen, fish must first discharge the CO_2 in their blood and this is a much slower process when there are high concentrations of carbon dioxide in the water. Therefore the amount of CO_2 dissolved in the water becomes an important indicator of the balance of life. Obtain a sample of water in the same way as described in activity B. Be sure to use a uniform method at all test sites. Follow the directions in the water test kit for the determination of free CO_2. Record your results accurately on the data sheet.

D. Measurement of the Relative Acidity or Basicity of Water - the pH Test.

On a scale of 1-14", water with a pH of 7.0 is neutral and is neither acid nor basic. Water above 7.0 is basic and water below 7.0 is acid. It is based on the hydrogenion concentration in the water. Excessive CO_2 changes the composition of water by making it more acid - lowering the pH. Most fish avoid waters that have rising concentrations of CO_2 or increasing acidity. Follow the directions in the water test kit to determine the pH of your water sample. The sample obtained in activity B may be used. Record your results on the data sheet.

E. Determination of Thermal Differences.

Pollution is usually thought of in terms of unsightly bottles and cans, dirty foam or an ugly scum on rivers and lakes. A more subtle environmental change, however, is that caused by returning waters heated by factories, power plants and nuclear reactors to a river or stream of a normally lower temperature. Such thermal change combines with other factors, such as oxygen content, mineral and organic material, to influence surrounding life and produce

undesirable and visible secondary effects. This test can be performed in conjunction with activity B by inserting a thermometer into the water sampling bottle for temperature readings. Record your results on the data sheet.

F. Determination of Turbidity or Degree of Visibility.

The Secchi Disk, found in the mobile lab is used for this test. Follow the directions carefully in carrying out this test. Best results are obtained when out of direct sunlight. Raise and lower the disk several times to obtain an average reading. Record your results on the data sheet.

INTERPRETATION:

1. Construct a graph or table comparing the amounts of oxygen in water at different temperatures.

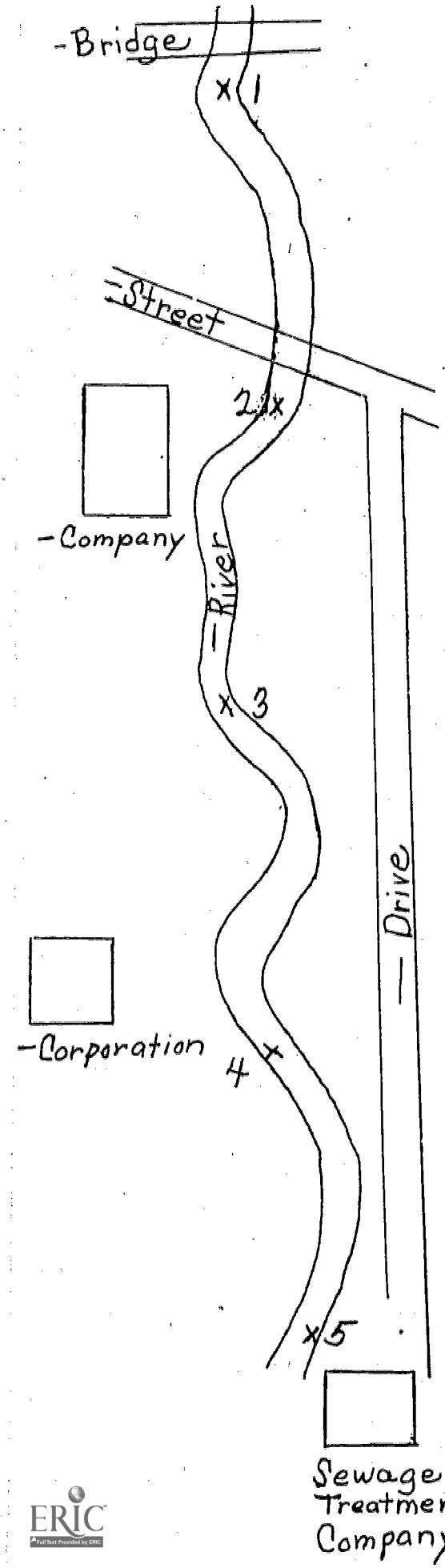
2. Construct a graph comparing carbon dioxide concentration to hydrogen ion concentration (pH).

3. Graph patterns of differences or similiarities among the measurements of thermal differences at different locations. Once patterns have been established answer the following questions:

   a. Does the temperature of the river or stream change as if flows down stream?

   b. Is the river or stream cleared of thermal differences? If so, at what point?

4. Go back to the test sites with the highest readings and investigate further. Look for pipes or gullies where heated water or other kinds of pollutants could be entering the river or stream. Prepare a list of these sources and their effluent.



Test Site	Date	O_2	CO_2	pH	( )	Thermal (Temp.)	Turb.
1.							
Ave.							
2.							
Ave.							
3.							
Ave.							
4.							
Ave.							
5.							
Ave.							

ENVIRONMENTAL INVESTIGATION: Interrelationships in an Aquatic Community

Suggested Grade Level: Secondary

Suggested Study Area: Allandale Farm (Lake), Bays Mountain Park

Equipment: 4 marking crayons, 2 jars (wide-mouth, screw-top), 1 liter, 7 jars wide-mouth, screw-top, 4 liters, 13 jars (wide-mouth, screw top) 0.5 to 1 liter, 1 plankton net, 1 can(size No. 3), lid smoothly removed, 1 seive (no. 8 mesh), 2 forceps, 6 plastic bags, 6 rubber bands, 1 plant - grappling bar, 4 trowels, 1 dip net, 1 wire-cloth seive, 1 waders, medicine droppers, microscopes, hand lens, microcope slides, cover slips, scapels, finger bowls or porcelain pans, reference books

THEME: Ponds have many advantages for the study of aquatic communities. They furnish a variety of habitats and have many relationships with the surrounding land. Natural ponds usually show the most complex relationships, but man-made ponds are both simpler to study and most widely distributed geographically.

Objectives:

To analyze plant and animal life found in and near a pond.

To collect samples of plant and animal life found in and near a pond.

To recognize some of the complex interrelationships existing in an aquatic community.

To generalize from data collected the influence of man on a given aquatic community.

PROCEDURE:

Four teams are needed: one to study plankton organisms; a second to study the organisms on the bottom of the pond; a third to study the large water plants; and a third to study the large water plants; and a fourth to study the larger animals of the pond.
All teams must be careful not to disturb the environment more than is absolutely necessary. This should present no problem for team 1; it will be more difficult for the others. Remember that only a few specimens of each species are needed.

Team 1:
Use a glass-marking crayon to label two wide-mouth, 1-liter jars as follows: Surface-Water Zone, and Deep-Water Zone.
Take the jars and the plankton net to a place on the shore from which the plankton net can be cast into the water. Fill each jar about one-third full of clear pond water. Cast the net into the water and pull it through the open-water zone. If the net is pulled rapidly, it will stay near the surface of the water. Pull the net through the water several times, then raise it.

You may be able to see a number of tiny organisms in the bottle. Untie the bottle from the net and empty its contents into the jar labeled Surface-Water Zone. Repeat the surface collecting 3 or 4 times. To collect organisms in the deep-water zone, allow the net to sink to the desired depth and then pull slowly. Place collections from the deep water in the second jar. Put the jars in the shade until you are ready to use them. If jars are left in the sunlight, the temperature in them will rise and many of the organisms will die.

The plankton organisms are mostly microscopic; use medicine droppers for handling the organisms, slides and cover slips for mounting them, and monocular microscopes for observing them.

Team 2:

Select three 0.5 liter jars and have 4 liter jars. Use a glass-marking crayon to label one of each size as follows:

Bottom: Emergent - plant zone
Bottom: Submerged - plant zone
Bottom: Open-water zone

Take the jars, a sieve, and a can to the pond. Fill each jar about one-half full of clear pond water. With the can, scoop up some mud from among the emergent plants. Dump this mud into the sieve; then shake the sieve in the water until the mud is washed out. Remove dead leaves and sticks by hand. Pick out whatever organisms you find, and put these into the appropriate 4-liter jar. Then carefully scoop up a small sample of the mud and place it in the appropriate 0.5 liter jar. Repeat this procedure in the other 2 zones. Hand lens or stereomicroscopes can be used to observe organisms washed from the mud. The organisms will be more easily seen if placed in a finger bowl over a piece of white paper, or in a white porcelain pan. Handle the larger organisms with forceps, the smaller ones with medicine droppers. Samples of mud in the small jars should be examined by placing a small bit of the mud in a drop of water on a microscope slide under a monocular microscope.

Team 3:

Use a glass-marking crayon to label six large plastic bags. Label two Emergent Plants, two Floating Plants, and two Submerged Plants. Take the labeled bags, six rubber bands (to fasten the bags shut), a trowel, and a plant grappling bar to the pond. In each of the three plant zones collect a specimen of each kind of plant found. Whenever possible the specimen should consist of a whole plant. Roots and underground stems are often important for identification. If the whole plant is too large, collect leaves and flowers and fruits. Put the plants of each zone into separate bags.

Hand lens, forceps, and finger bowls are the only tools needed for examining the collections of these two teams. (3 & 4)

Team 4:

Select 10 jars varying from 0.5 to 1 liter in capacity. Using a glass-marking crayon, label five of the jars Emergent-and Floating-Plant Zone. Select four 4-liter jars, and label two of the Emergent-Plant Zone and the other two Submerged Plant Zone. Take all the jars, and dip net, and a sieve to the pond. One member of the team should be assigned to record

animals that seem to be a part of the pond community, whether they live in the pond or not. Use the dip net or the sieve to collect the larger animals - for example: fish, crayfish, some of the larger insect larva, turtles, and snakes. The smaller ones will go through the holes in the collecting equipment. First catch the animals in the emergent-plant zone, near the edge of the pond. Put them into labeled jars. Insect larva may be placed together in the same jar, with some sticks and leave for shelter. Only a few fish should be placed together in one jar. Use the smaller jars for specimens that might injure one another. Be careful in handling animals; some of the insects, as well as larger animals, can inflict painful bites. In a similar manner collect organisms in the submerged-plant zone. Do not collect more than one or two specimens of each of the larger animals.
Hand lens, forceps, and finger bowls are the only tools needed for examining the collections of these two teams. (3 & 4)

Each team will study its own collections and report its findings to the class. The organisms must be identified. First use whatever other guides are available in the mobile van. Most organisms should be identifiable to lower levels. Specific identification is not necessary. This exercise is not designed as a quantative study, but some idea of the relative abundance of different kinds of organisms will be useful in forming an understanding of the community. Whenever possible, record your observations with respect to numbers of identified organisms in the pond community.

INTERPRETATION:

1. Can you see any relationship between the size of organisms and their relative abundance? if so, what is the relationship and how can you explain it?

2. Consider the relationship between the pond and surrounding community on the land. How does energy received from the sun flow from the pond community into land communities? Is there any reverse flow of energy? If so, how does it occur?

3. Based on your investigations, what influence has man had on the interrelationship existing in the community?

4. If this influence was detrimental, what corrective action would you suggest?

Kingdom Phylum Order Family Genus Species

Data Sheet Team No._____

Name of Organism	Kingdom	Phylum	Number of Organisms	Zone

Guide to Some Common Freshwater Organisms

Microscopic Organisms

AMEBOIDS: Pseudopods present. (a) Actinosphaerium (spherical, with stiff radiating projections); (b) Amoeba (pseudopods, no shell); (c) Arcella (shell present)

CILIATES: Cilia on all or part of body. No flagella. Some have chlorophyll. (a) Colpoda; (b) Vorticella; (c) Paramecium; (d) Stentor; (e) Euglena intermedia; (f) Euglena intermedia(contracted); (g) Euglena ascus; (h) Spirostomum, (i) Tetrahymena, (j) Didinium; (k) Prorodon

UNICELLULAR FLAGELLATES: One of more long whiplike flagella. With or without cilia. Colorless. (a) Spironomas; (b) Collodicyton; (c) Colponema

COLONIAL FLAGELLATES: (a) Codonodendron; (b) Volvox(constantly rotating); (c) Pandorina

ROTIFERS: Bnads of cilia near mouth. Colorless. (a) Synchaeta; (b) Asplanchna; (c) Philodina; (d) Keratella

COPEPODS: Small crustaceans with several hairlike spines at tip of abdomen. Body elongated. (a) Halicyclops; (b) Diaptomus (a larval state); (c) Diaptomus (adult)

OSTRACODS: Small crustaceans with no spines. Body covered by a jointed carapace, somewhat resembling small clam shells.

CLADOCERANS: Small crustaceans with no spines at tip of abdomen or a single spine only. Body short. (a) Daphnia (female); (b) Daphnia (male); (c) Ceriodaphnia

OPOSSUM SHRIMP: Carapace covers most of thorax. All limbs of thorax similar. Eyes stalked. No gills in most species.

WATER MITE: Body not jointed. Eight jointed legs.

SCUD: No carapace. Limbs of thorax different from each other. Eyes not stalked. Body compressed laterally. Gills present.

CRAYFISHES: Carapace not jointed. Pincers on anterior legs.

MAYFLIES: Adults usually have clear, narrow wings. Wings usually held vertcially when at rest. Larvae aquatic. Adults and larvae with three "hairs" at end of abdomen.

CADDIS FLIES: Adults have clear, broad wings. Larvae aquatic, wingless, and usually live within a case composed of pebbles or debris.

DRAGONFLIES: Adults large, usually clear-winged. Wings extend horizontally when at rest. Large eyes. Larvae aquatic. End of abdomen without "hairs."

MOSQUITOES: Adult has only one pair of wings. Larvae small, without legs, float at surface of water, and breathe air through tubes.

BEETLES; Adult has a pair of hard wing covers, not overlapping. Larvae wingless. Example: water scavanger.

BUGS: Adult has a pair of overlapping wings. No hard wing covers. Larvae wingless. Example: giant water bug.

Annelids, Mollusks, and Vertebrates

LEECHES: Segmented worms with flat bodies. Usually with suction disks at both ends.

MUSSELS: Mollusks with shells in two parts, hinged together.

SNAILS: Millusks with shells in one part, usually coiled.

BONY FISHES: Vertebrates with paired fins. Gills concealed beneath a single coverning, the operculum. Examples: minnow, bass, white sucker, carp, perch, pickerel, pike, catfish.

SIMPLE BLUE-GREEN ALGAE: Dark green or blue-green clusters in gelatinous sheaths. (a) Chroococcus; (b) Gloeocapsa

FILAMENTOUS BLUE-GREEN ALGAE: (a) Gloeotrichia (in gelatinous sheaths that often run together); (b) Rivularia(tapering filaments in sheaths); (c) Nostoc (firm sheaths); (d) Anabaena (cells of different sizes, in chains); (e) Lyngbya(thin sheaths); (f) Oscillatoria (no sheaths)

SINGLE-CELLED GREEN ALGAE: (a) Ankistrodesmus; (b) Protococcus; (c) Euastrum; (d) Cosmarium; (e) Chlorella; (f) Staurastrum; (g) Selenastrum; (h) Xanthidium;

COLONIAL GREEN ALGAE: (a) Sphaerocystis; (b) Dictyocphaerium; (c) Hydrodicyton; (d) Coleochaete; (e) Scenedesmus; (f) Pediastrum; (g) Sorastrum; (h) Chaetophora

GOLDEN ALGAE (DIATOMS): Unicellular or loosely colonial algae. Walls of silica, consisting of two overlapping halves that fit together like the halves of a petri dish. (a) Stephanodiscus; (b) Navicula gracilis; (c) Navicula rhynocephala; (d) Diatoma elongatum; (e) Diatoma hiemale (girdle view); (f) Diatoma hiemale (valve view); (g) Cymbella; (h) Pinnularia; (i) Asterionella; (j) Tabellaria

OTHER GOLDEN ALGAE: (a) Monocila (branching filaments); (b) Leuvenia (ovoid or pear-shaped, solitary); (c) Tribone (cells cylindrical, joined end-to-end); (d) Chrysidiastrum (amoeboid cells joined in free floating colonies); (e) Botrycoccus (compact, irregular, gelatinous, semi-opaque masses)

MOSSES: Submerged or emergent. Erect, feathery stalks.

LIVERWORTS: Flat and ribbon-like. Rootlike structures on undersurface. Above: Ricciocarpus; below:Riccia

SMARTWEEDS: Emergent. Small flowers in dense clusters.

SEDGES: Emergent. Stems triangular in cross section.

ARROWHEAD: Emergent. Leaves shaped like broad spearheads.

CHARA: Submerged. An alga with whorled branches.

BUR REED: Emergent. Long grasslike leaves may be submerged.

DUCKWEED: Floating. Roots hang in water. Frequently forms extensive mats.

COONTAIL: Submerged. Leaves stiff, hairlike, branched in whorls. No roots.

RUSHES: Emergent. Leaves grasslike. Clusters of small fruiting structures.

CATTAILS: Emergent. Tall grasslike leaves. Long brown fruiting structures.

TAPE GRASS: Submerged. Leaves ribbon-like. Plant rooted to bottom. Flowers break off and float to surface.

MARE'S TAIL: Submerged. Leaves small, simple, in whorls.

PICKERELWEED: Emergent. Leaves heart-shaped. Flowers (purple) tightly clustered on slender spike.

SALAMANDERS: Tailed amphibians with paired appendages and toes. Gills (when present) without a covering. Examples: spotted salamander, mud puppy, newt

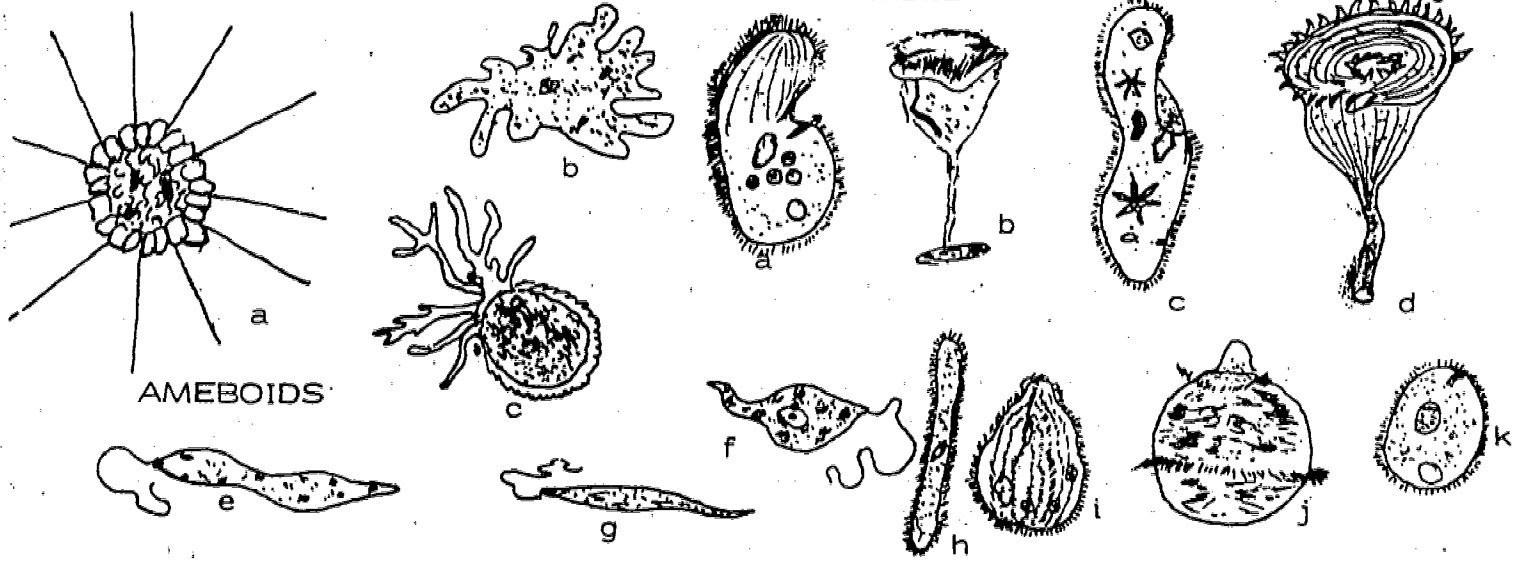
Vertebrates

FROGS: Tailless amphibians. Posterior pair of appendages longer than anterior pair; used in leaping. Examples: bullfrog, leopard frog

TURTLES: Reptiles with a broad, flat form. Usually with an armor of bony plates Examples: soft-shell turtle, snapping turtle

BIRDS: Vertebrates with feathers. Examples: coot, goose, pied-billed grebe, sandpiper(Birds of freshwater habitats are of many kinds; see text for illustrations of ducks, herons, plovers, and gulls)

MAMMALS: Vertebrates with hair. Feed young with milk. Example: muskrat (see text for illustrations for other mammals important in freshwater habitats-mink, beaver, moose, etc.)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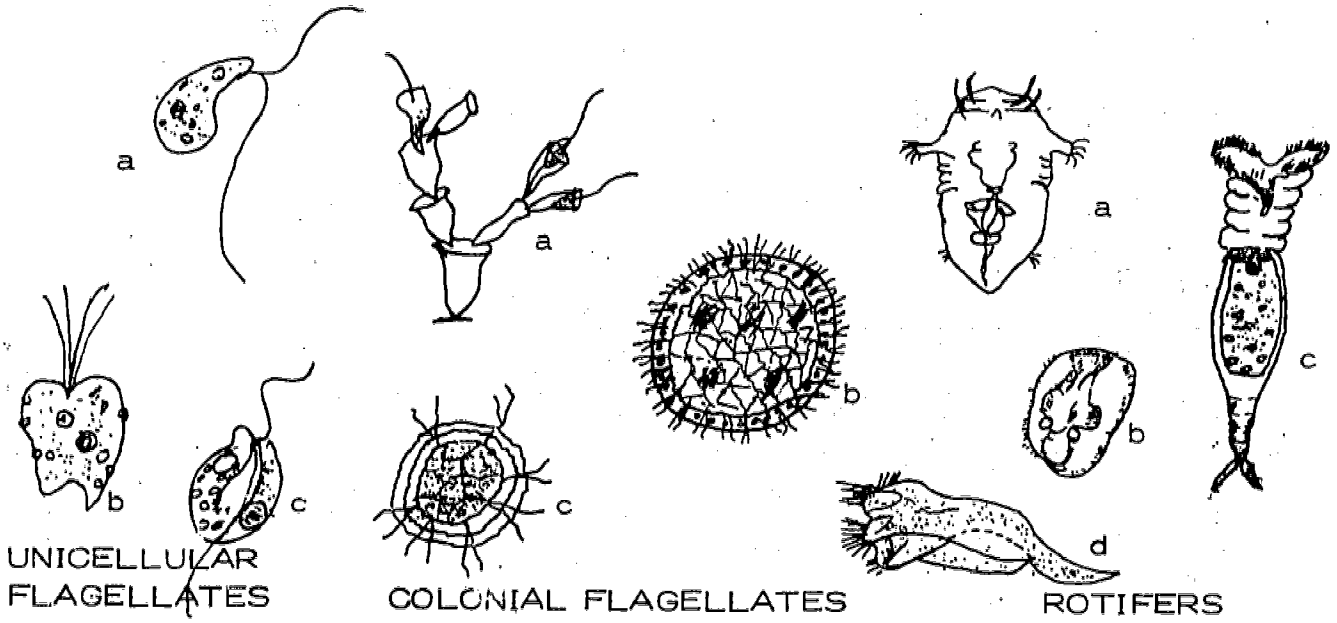
CILIATES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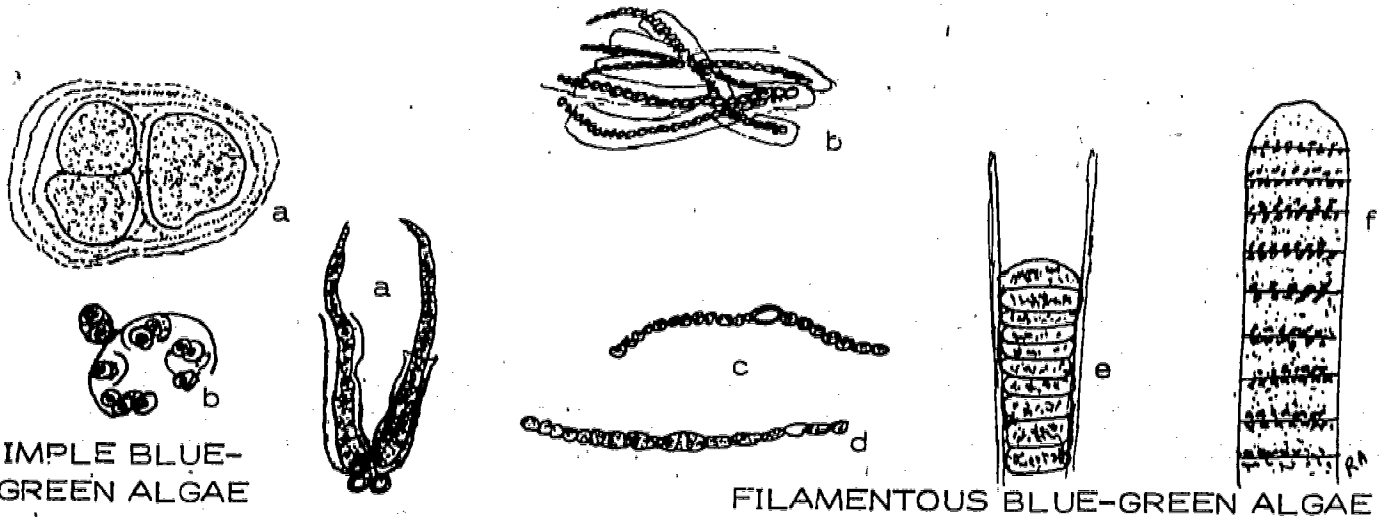
UNICELLULAR FLAGELLATES
COLONIAL FLAGELLATES
ROTIFERS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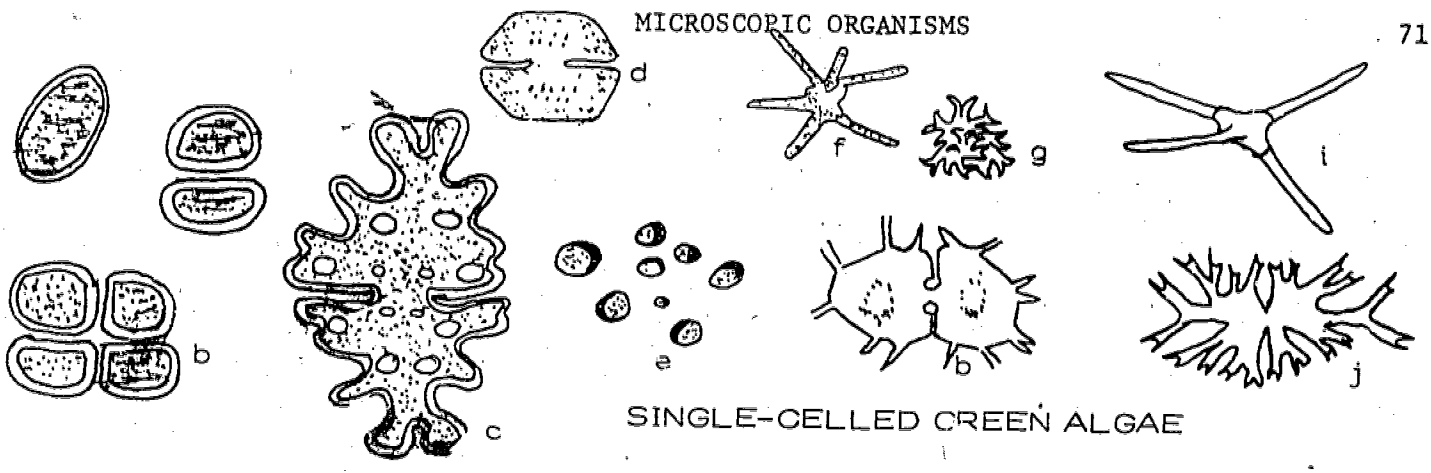
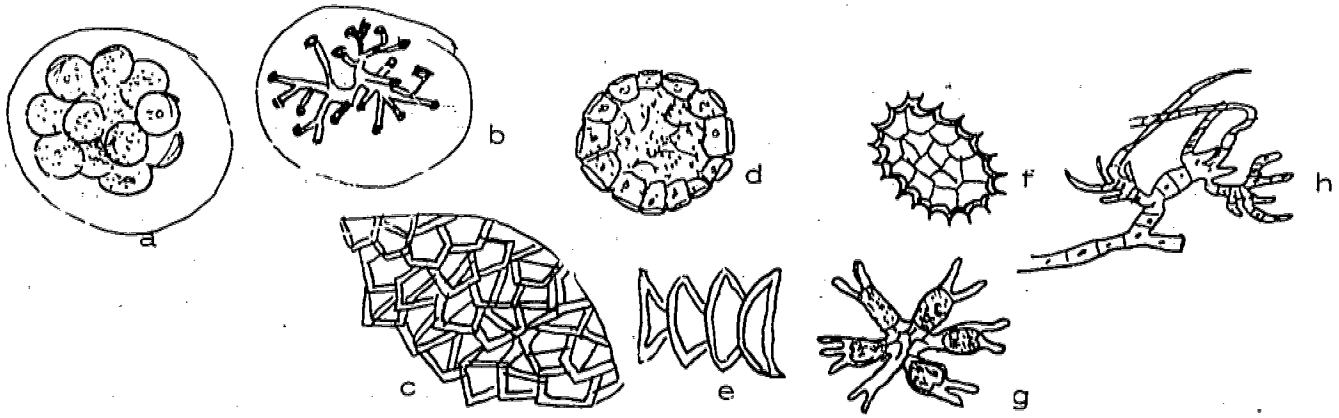
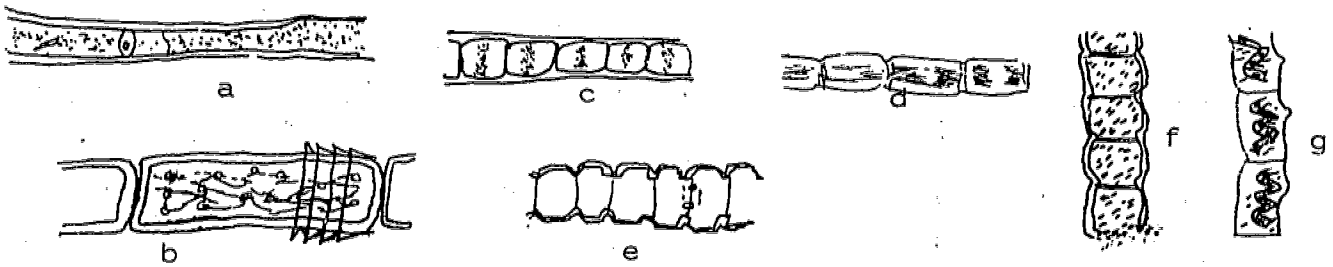
SIMPLE BLUE-GREEN ALGAE
FILAMENTOUS BLUE-GREEN ALGAE



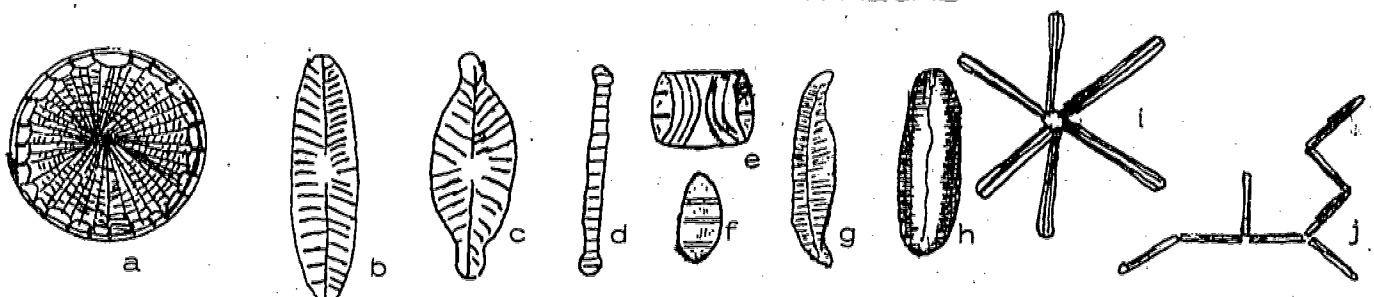
SINGLE-CELLED GREEN ALGAE



COLONIAL GREEN ALGAE



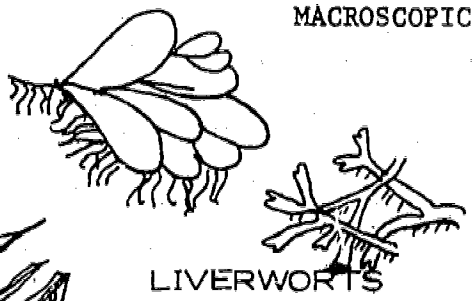
FILAMENTOUS GREEN ALGAE

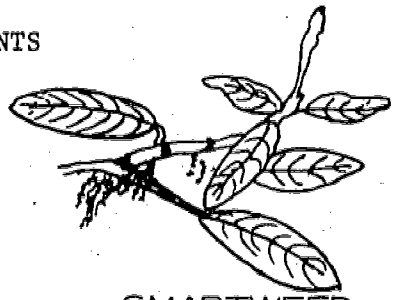


GOLDEN ALGAE (DIATOMS)

OTHER GOLDEN ALGAE


MOSS


LIVERWORTS

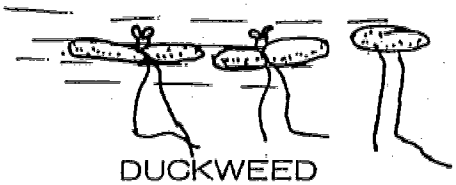

SMARTWEED


SEDGE


ARROWHEAD


CHARA


BUR REED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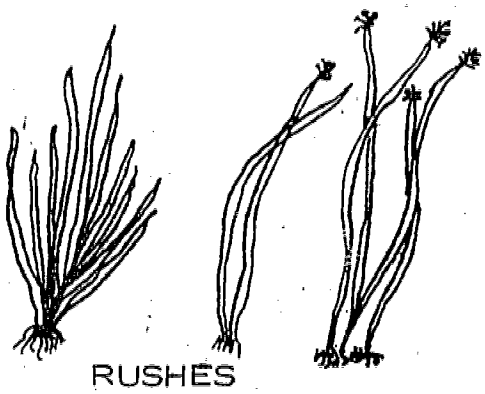
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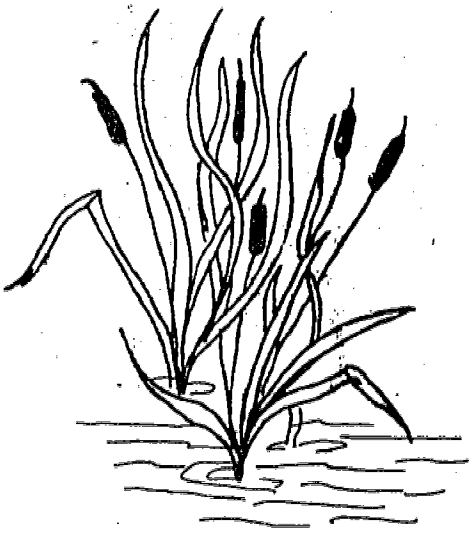
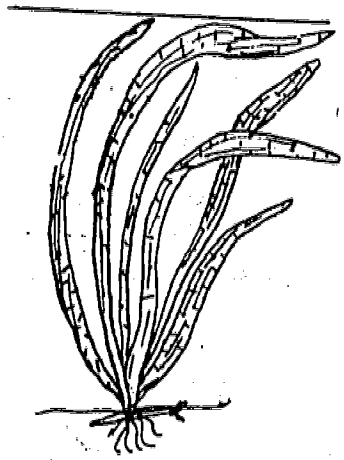

CATTAILS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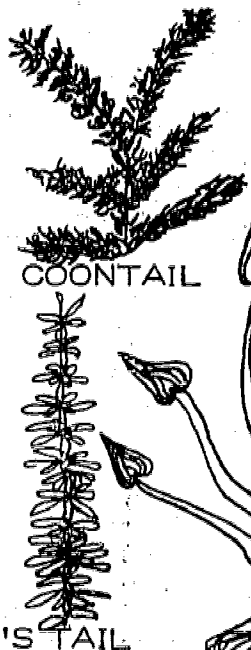
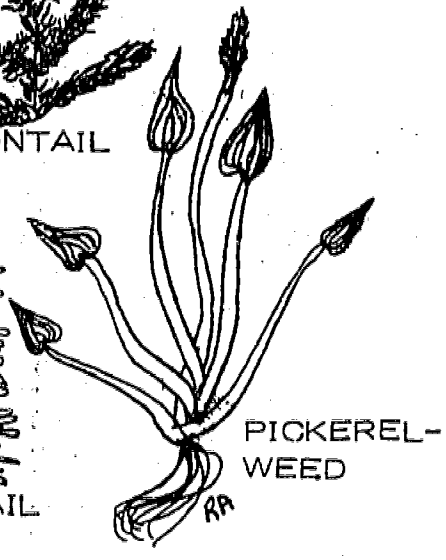
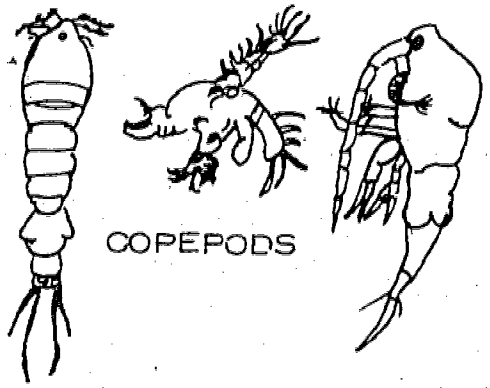
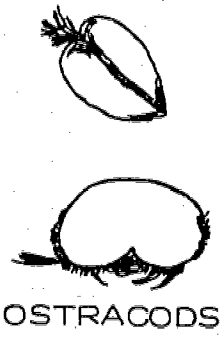

COONTAIL

MARE'S TAIL


PICKEREL-WEED


COPEPODS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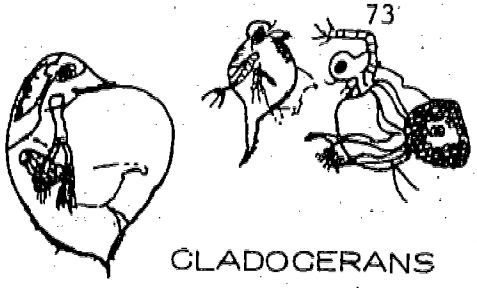
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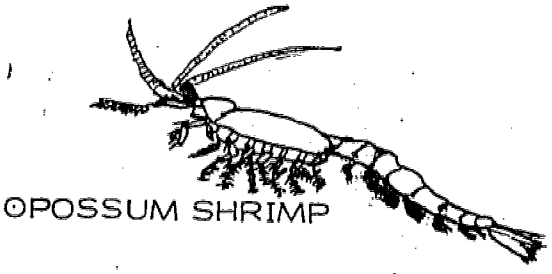
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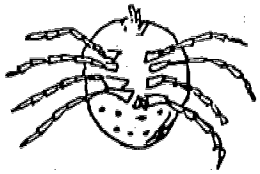
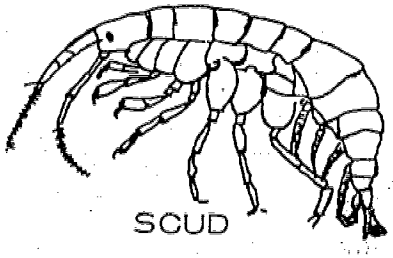

WATER MITE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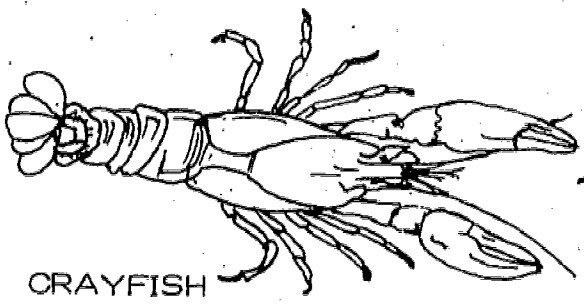
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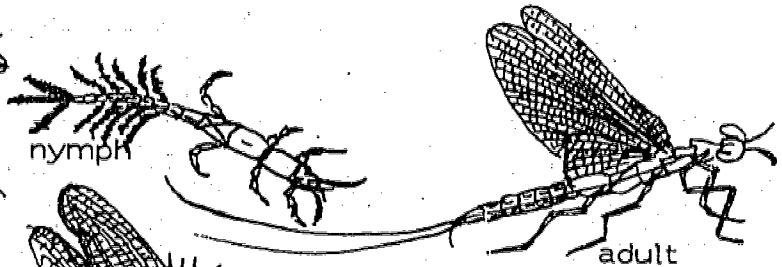
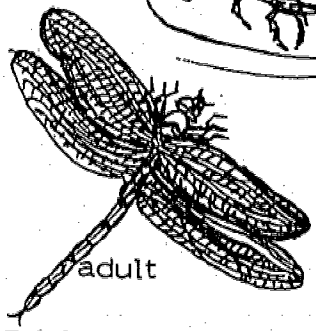


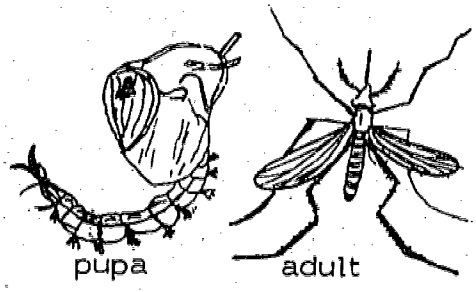
MAYFLY


larva

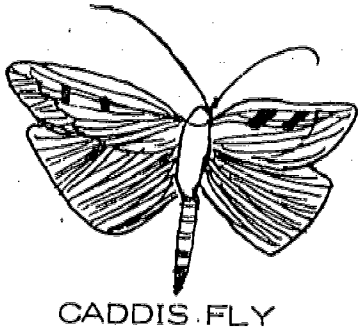

nymph



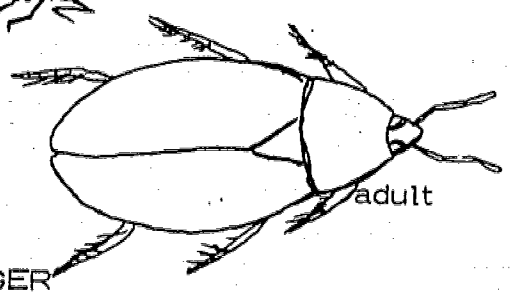
DRAGONFLY



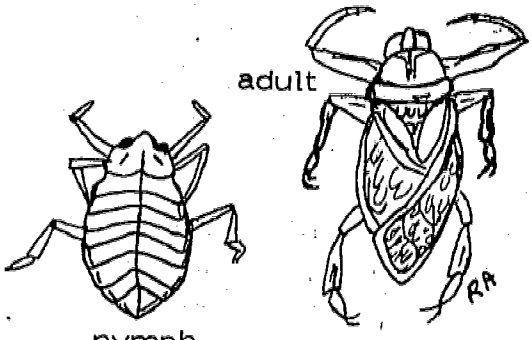
MOSQUITO


CADDIS FLY


larva

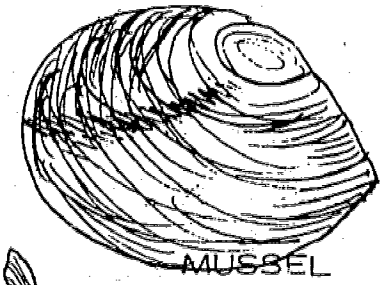


WATER SCAVENGER

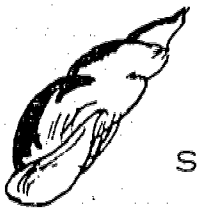


GIANT WATER BUG

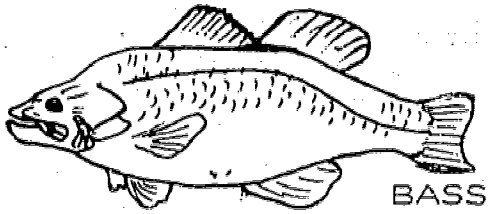
LEECH



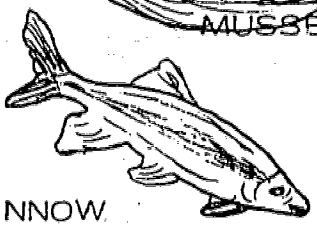
MUSSEL



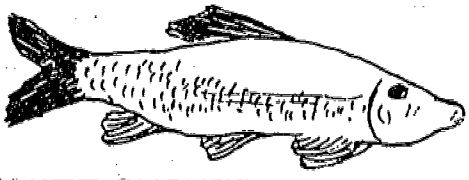
SNAIL



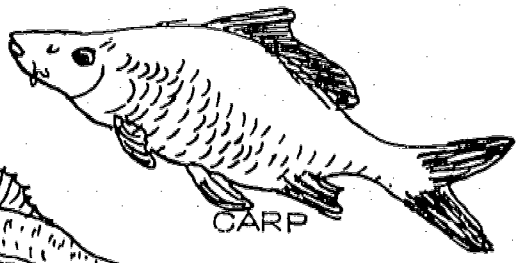
BASS



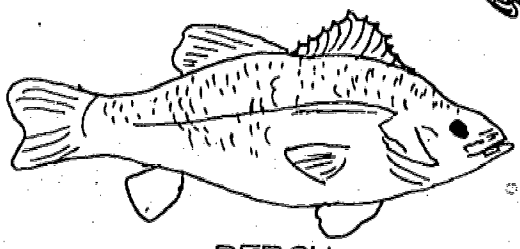
MINNOW



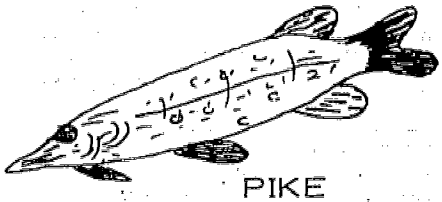
WHITE SUCKER



CARP

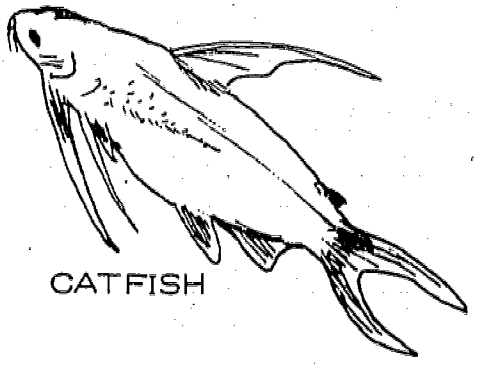


PERCH

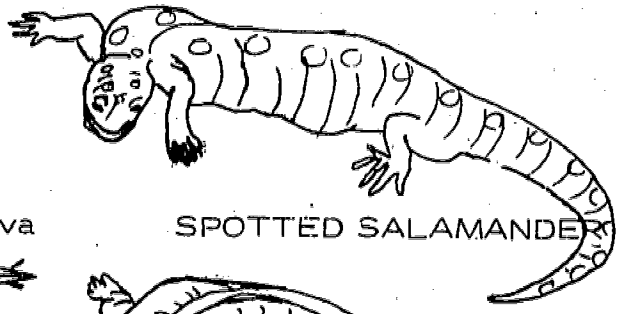


PIKE

PICKEREL

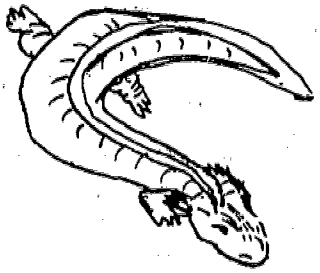


CATFISH



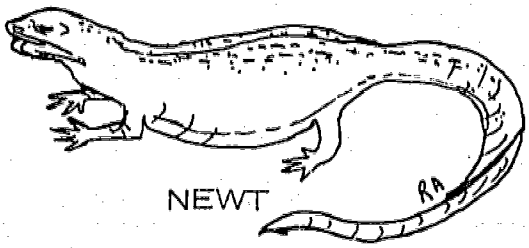
SPOTTED SALAMANDER

larva

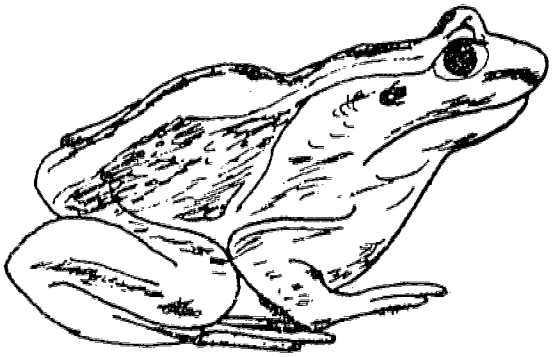


MUD PUPPY

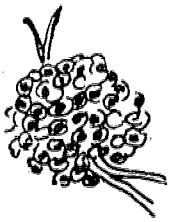
larva



NEWT

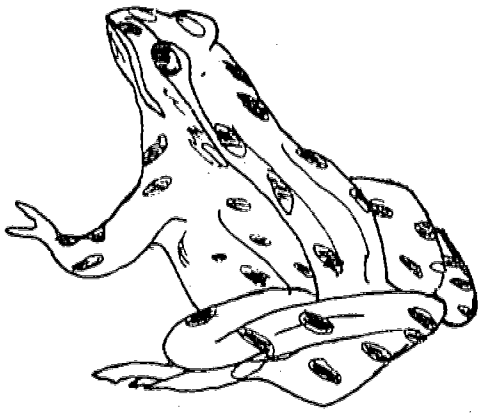


BULLFROG

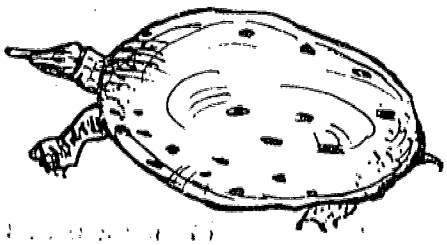


eggs

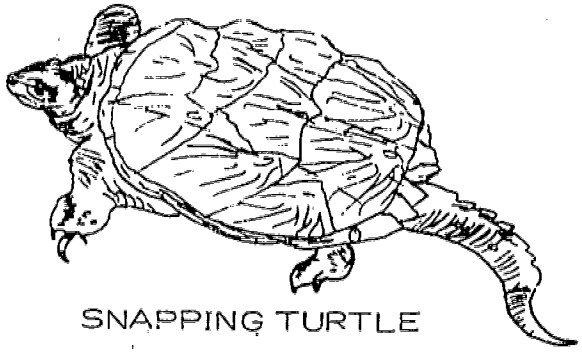
tadpole



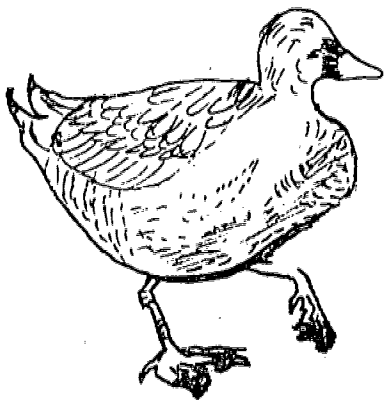
LEOPARD FROG



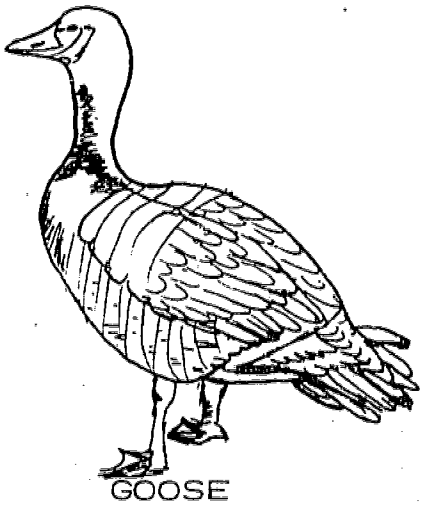
SOFT-SHELL TURTLE



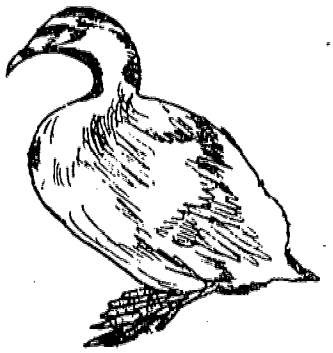
SNAPPING TURTLE



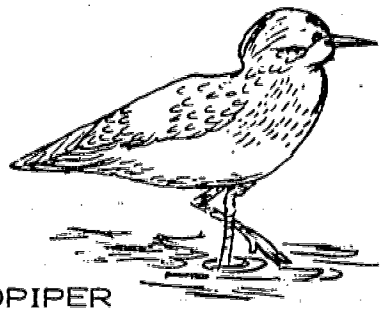
COOT



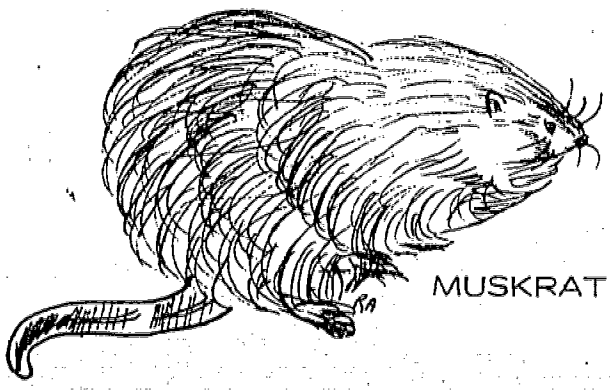
GOOSE



PIED-BILLED GREBE



SANDPIPER



MUSKRAT

ENVIRONMENTAL INVESTIGATION: Sulfur Dioxide Damage to the White Pine Tree

Suggested Grade Level: Secondary

Suggested Study Areas: Any of the local designated school areas containing numerous species of white pine trees.

Equipment: Small plastic or paper envelopes, about 3" x 4" to hold samples, small identification tags for samples, small stapler, microscope and small magnifying glass, aluminum tags 2"x 3" for tree identification

THEME: Poisonous gases such as sulfur dioxide affects, not only man, but other organisms in his environment.

Objectives:

To examine and identify local flora.

To determine the effects of sulfur dioxide on plant growth.

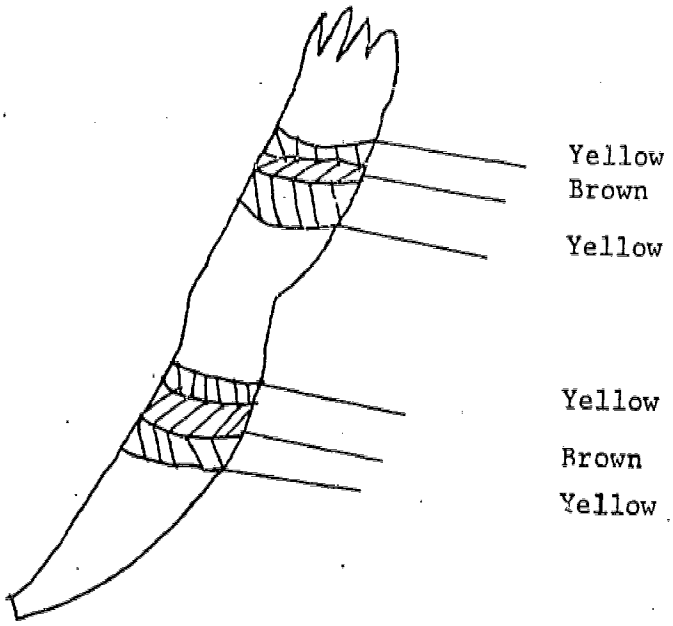
To estimate the economic loss to the timber industry resulting from one type of air pollution.

To determine possible sources of sulfur dioxide pollution.

Background Information:

Sulfur dioxide, one of our most prevalent gaseous air contaminants is formed during the combustion of most fuels and during the smelting and processing of sulfur bearing materials. Very low concentrations of this contiminating gas in air attack susceptible strains of white pine trees. This attack is first noticeable by a characteristic marking of the tree's needles. This marking is usually one or more dark brown bands, each brown band having two adjacent yellow bands. Microscopic examination reveals a swelling of the needle at these bands. Tree growth may be stunted in proportion to needle damage. Sulfur dioxide damage should not be confused with that caused by fluoride damage, the young needles develop yellow tips which collapse and turn reddish brown. It should also be noted that plant disease at times cause certain markings of needles.

Have each student look for the characteristic markings caused by exposure to low concentrations of sulfur dioxide, as illustrated in the accompanying enlarged sketch.



Remove a few typically affected needles from each tree on which found. Place the needles carefully in an envelope and attach a tag showing identification and location of the tree. Attach an identifying aluminum tag to the tree to mark it for examination by the biology class next year.
Examine the needles under the microscope when you return to the Mobile laboratory. Note the appearance of affected versus unaffected portions of needles from different trees, as follows:

a. Outer surface
b. Thin cross-sectional slices (making these and anaylzing with microscopes)
c. Thin longitudinal-section slices (" " " " ")

Each student should keep neat and complete records of all observations. These records will be useful to the class next year and succeeding years in noting how tree growth might be affected.

Record your information on the attached sheet.

Data Sheet

Specimen Number (from identification tag)	Date of Observation	Place of Observation	Visable Effects of Sulfur Dioxide				Probable Source of SO_2
			1st yr.	2nd yr.	3rd yr.	4th yr.	

INTERPRETATION:

1. From the information gathered, can you determine if sulfur dioxide is having an adverse affect on the white pine in your area?

2. Is there a relationship between the degree of damage and the proximi ty of the pollution?

ENVIRONMENTAL INVESTIGATION: Factors Affecting Weather

Suggested Grade Level: Secondary

Suggested Study Area: School Campus

Equipment: Thermometer (centigrade), Anemometer, Barmometer, Psychrometer

THEME: Weather is affected by many environmental factors.

Objectives:

To prepare a weather report.

To examine and use several simple weather measuring devices.

To identify various weather conditions which can be defined and measured.

To analyze the affect of various weather conditions on air quality.

PROCEDURE:

Measure Air Temperature

When air temperature readings are taken, the thermometer should be held away from your body and in such a way that fingers do not warm the bulb. The thermometer must be shaded from the sun or the bulb will be heated above air temperature. Read the thermometer only after the indicator fluid stops moving .

Meausre Wind Speed

An anemometer measures wind speed in miles per hour. The anemometer must be balanced to work well--the better the balance the more sensitive the device .

Measure Humidity

Humidity is measured by a psychrometer in terms of percentage of mositure or water vapor present in the air .

Measure Atmospheric Pressure

Atmospheric pressure is measured by means of an instrument called a barometer in terms of the pounds of pressure exerted per square inch .

INTERPRETATION:

Study the "Weather Forecasting Information" data sheet. By using your weather measuring equipment, complete the data sheet entitled, "Weather Observation Report".

WEATHER OBSERVATION REPORT

Date_____ Time_____ Observer(s)_____

Temperature

Present reading_____degrees
Last reading_____degrees

Barometer

Present reading_____inches
Last reading_____inches
Check one: Barometer is
rising_____falling_____
steady_____

Wind

Direction wind coming_____
Speed of wind_____m.p.h.

Clouds

Type of clouds_____
% of overcast_____%

Humidity:

Hygrometer reading_____%

Precipitation

Check correct one:
Rain_____snow_____sleet_____
Frost_____fog_____none_____

Amount of percipitation

Inches_____Trace_____

MY PREDICTION FOR THE NEXT 24 HOURS:

BEAUFORT WIND SCALE

M.P.H.

Less than one, smoke rises vertically
1-3 direction shown by smoke
4-8 leaves rustle, vane moved by wind
9-12 leaves and twigs in constant motion
13-18 raises dust and paper
19-24 small trees sway
25-31 large branches move
32-38 whole trees move
39-46 twigs break off trees
47-54 light storm damage
55-63 trees uprooted
64-75 rarely encountered, widespread damage
75+ evacuate to safe surroundings

WEATHER OR NOT?

(Famous Weather Sayings)
Are these fact or superstition?

When squirrels lay in a big store of nuts, look for a hard winter.

When ants travel in a straight line, expect rain; when ants scatter, expect fair weather.

The higher the clouds, the better the weather.

Red sky at night - sailor's delight!
Red sky in morning -sailor's take warning

THERE'S NEWS IN THE WIND!

WEATHER FORECASTING INFORMATION

Each obserber forecasts the weather using his own observation in conjunction with preceding reports. Forecasts are often based on rules and relationships like the following from various reference books.

1. A falling barometer indicates an approaching "low" with a storm.

2. A rising barometer indicated the passing of the "low" and the approach of a "high" and fair weather.

3. The passing of a "low" in summer will be followed by warmer weather.

4. The passing of a "low" in winter will be followed by colder weather, perhaps with a "cold front" blowing from the "Far North" and with blizzards in regions east of the Far West.

5. Winds from the south or southeast foretell a "low" coming from the west with its center to the north of the observer, and with rain to come within 24 hours or sooner.

6. Winds from the east or northeast foretell a "low" coming from the west with its center to the west or to the south of the observer, usually with heavy, chilly rain, and cold weather.

7. Winds swinging from the southeast to the southwest indicate that the center of the "low" has passed to the east of the observer and that fair and colder weather will soon follow.

8. Winds swinging from the east or northeast to the northwest also indicate that the center of the "low" has passed to the east of the observer and that fair and colder weather will soon follow.

9. Cirrus and cirro-stratus clouds, coming from the west with a gray sky, indicate the approach of a "low" with a storm.

10. A bright blue sky with cirrus wisps and with the wind in the west or northwest will be followed by fair weather for 24 to 48 hours or longer.

11. A bright blue sky with numerous cumulus clouds may be followed by strato-cumulus and rain or snow flurries during the middle of the day and early afternoon, but fair at sundown.

12. Calm, humid, warm to hot days during the spring may be expected to produce thunder storms.

13. If the lightning of a thunderstorm appears to the northwest, west, or south-west, the thunderstorm will come nearer the observer and perhaps pass overhead.

14. If in fall or spring the temperature falls at the end of a clear, calm day to 40 or 45 degrees Fahrenheit, one may expect frost in all low places by morning.

15. Frost will not form under the conditions above if clouds cover the sky before the morning or if a wind of any sort blows during the night.

16. Dew will form every night if there is no wind and the sky is clear so that ground heat may be radiated to space.

ENVIRONMENTAL INVESTIGATION: Measuring Carbon Monoxide

Suggested Grade Level: Secondary

Suggested Study Areas: This experiment may be used at any outside location or at the immediate site of an automobile exhaust system.

Equipment: Air pollution tester and replacement ampules

THEME: Carbon monoxide is a colorless, odorless gas that is formed by the incomplete combustion of carbonaceous materials. This experiment can be used to make quantitative measurements of CO within the ranges that are considered to have physiological effects on man and animals. It may also be used qualitatively to detect emission sources from industrial sites.

Background Information:

Studies have indicated that 95% of the carbon monoxide in the air comes from automobile exhaust gases and the remaining 5% from industrial and other sources. Federal regulations limit the CO content of exhaust gases from 1968 automobiles to 1.5% maximum. In confined spaces, especially in the home, dangerous levels of CO can come from improperly operating space heaters, hot water heaters and cooking stoves. It is also interesting to learn that the smoke from cigarettes contains 200-400 parts per million of CO.

Objectives:

To identify various types of equipment and methods of measuring atmospheric gases.

To generalize from data collected as to the magnitude of the CO problem.

To become aware of the danger of air pollution to public health and especially to the immediate environment.

PROCEDURE:

Divide the class into four groups and instruct each group to select a location suitable for using the air pollution tester.
Permit one group to test and measure the emission of gases coming from an automobile exhaust pipe.

The measurement of the level of concentrations of carbon monoxide should be compared to the limit ranges set by the American Conference of Government Industrial Hygienists. These limit ranges accompany the Air Pollution Tester Kit.
By using the same general procedure and equipment, the following gases (CO_2, H_2S, NO_2, SO_2) may also be tested, measured and compared to the limit ranges.

INTERPRETATION:

1. Do the measurements of the atmospheric gases you obtained exceed the standard set by the government agencies?

2. What are the probable sources of the excessive carbon monoxide?

3. Can you find any evidence of the affect these gases have on other living organisms in the environment?

4. What suggestions might you as a student make to reduce or prevent excessive carbon monoxide in the atmosphere?

Data Sheet

Date	Time	Location	Carbon Monoxide Reading	Other Atmospheric Gases

LIVING ORGANISMS

ENVIRONMENTAL INVESTIGATION: An Investigation of Tree Diversity and Growth

Suggested Grade Level: Upper Elementary

Suggested Study Areas: Dickson Nature Park, Wooded School Sites, Bays Mountain Park, Roller Woods

Equipment: Tree identification guide, tape measure, data sheets, clipboards

THEME: A wooded area usually contains several different species of trees in varied stages of growth. In many situations man has affected the diversity and growth of trees.
When a wooded area is surveyed to determine the number of trees of each species the following classification system is used:

0 - 1" diameter - Seedling
1" - 4" diameter - Reproduction
4" - diameter - Mature

Objectives:

To investigate the affect of man on the growth and diversity of trees.

To develop an awareness of the interrelationship and interdependence that exist within a forest community.

To calculate tree diversity by using the Belt transect method.

To develop skills in identifying characteristics of individual trees.

PROCEDURE:

Using the procedure described below, sample a wooded area to the number of trees of each species found. Use the data sheet to record your observations.

A. After an area for study has been chosen using a tape measure, calculate the area of the woodlot in square yards.

B. An orderly method for surveying the area must be determined.

1. Cross the area from side to side at intervals of 25 yards. These lines, spaced 25 yards apart, are called transect lines.

2. Count the trees that lie within five feet of your path on either side of the transect lines. This 10' wide area is known as a transect belt.

3. Using the data sheet supplied, record the name and classification (according to size) of each tree encountered. It is quite obvious that not every tree in the woodlot will be counted.

However, by using this method a very accurate estimation can be made.

DATA SHEET

TREE DIVERSITY

A. Size of area surveyed:

Length_____yd. x Width_____yd. = _____sq. yd.

B. 1. Sketch the area being surveyed. Include proper measurements and the correct number of transect lines.

2.

Tree Species	0-1"	1"-4	4"-	Total
Total				

C. 1. Calculate the total density of the woodlot.

$$\text{Total density} = \frac{\text{Total number of trees counted}}{\text{Area of the woodlot in sq. yards}}$$

2. Calculate the species density for each species encountered.

$$\text{Species density} = \frac{\text{Total number of each species counted}}{\text{Area of woodlot in square yards}}$$

3. Calculate the relative density for the woodlot

$$\text{Relative density} = \frac{\text{Total number of species counted X 100}}{\text{Total number of trees counted}}$$

INTERPRETATION:

1. What percentage of all trees counted were in the:

   Seedling stage_____%

   Reproduction stage_____%

   Mature stage_____%

2. What species of trees was:

   Most abundant_____

   Least abundant_____

3. Using the data collected, can you discover any evidence of man's interference with the tree growth in this woodlot.

ENVIRONMENTAL INVESTIGATION: Adoption of a Tree

Suggested Grade Level: Upper Elementary

Suggested Study Area: Nearby area where different kinds of trees are growing

Equipment: Camera, hand lenses, microscopes, Biltmore stock, clipboards, soil testing kit (for pH), equipment for securing soil samples

THEME: Seemingly unchanging, trees are constantly being varied by their environment.

Objectives:

Identify some of the interrelationships existing between a tree and it's environment.

Develop skills in gathering data, map making, graphic sketching, photography, and measurement.

Describe factors which reflect the way trees adapt to climatic soil, and other environmental conditions.

To develop an awareness that living organisms are constantly changing.

To identify ways in which man and trees are interrelated.

Activity:

Groups in class may adopt a tree or some individuals in the room may adopt their own tree. Each group will prepare a booklet of data for their tree. If there are individuals studying their own tree, each will develop his own individual booklet.

Pupils should have a copy of "Instructions To Students On Preparing Data Booklet For Tree Watching" to study before going in the field and also to take along with them. They should take paper and pencils for data gathering. This activity should be repeated 2 or 3 times during the year at different seasons to note changes in data from booklet.

The following acrivities will be a part of the tree observation.

1. Select a tree
2. Draw the tree from different views
3. Photograph the tree (if possible)
4. Select a leaf sample. Examine with hand lens and microscope
5. Map - draw a map of location
6. Observe branching patterns
   a. opposite
   b. alternating

7. Find any visible damage to tree and draw
   a. holes (large)
   b. small holes
   c. small tunnels
   d. eaten tunnels
   e. broken branches
   f. fungus plants
      (1) tangled pieces of white bread
      (2) looks like rows of shelves
      (3) black bubbly, hard masses on small branches
   g. aphids - tiny green insects on leaves
   h. lichens
      (1) small flat plants
      (2) gold, green, gray, or yellow
8. Measure diameter of tree with Biltmore stick
9. List and draw signs of companions
   a. Tracks
   b. Nests
   c. Homes in holes
   d. Webs
   e. Woodpecker hole
   f. Caterpillars
   g. Ants
   h. Butterflies and moths
   i. Other insects
   j. Birds
   k. Squirrel
   l. Owl
   m. Droppings
10. Soil Study
    Take samplings of surface soil, 6" below surface, 12" below the surface. Test for pH. Sample under tree and around tree.

INTERPRETATION:

Using the following guidelines, construct a booklet on each tree.

Instructions To Students On Preparing Data Booklet On Tree Watching

1. Cover
   a. a design planned by the group
   b. drawing of tree, make drawings of tree from all sides, label, artist, date, direction viewed
   c. photograph

2. Maps to show location of tree from school
   a. tree and school
   b. tree, school, and other trees

3. Description - Written
   a. general size - height
   b. general shape
   c. leaf color - budding branch tip
   d. bark color
   e. location
   f. diameter of trunk, etc.

4. Drawing of branching pattern from small branch
   a. opposite
   b. alternating

5. List and drawings of damage and possible cause - animals, aphids, lichens, man, weather, holes, small holes, tunnels, eaten leaves, broken branches, fungus, plants

6. List and drawings of animal companions
   a. signs of animals - tracks, nests, homes in holes, webs, woodpecker hole, droppings
   b. animals sighted - caterpillars, ants, butterflies, other insects, birds, squirrels, owls

7. Soil Study
   Select several locations around the tree and secure samples of surface soil, 6" below surface, 12" below surface, and test pH factor. Write up factors of tests, color of soil, moisture content and texture (sandy, floury).

ENVIRONMENTAL INVESTIGATION: Tree Measurement - Volume and Value

Suggested Grade Level: Upper Elementary

Suggested Study Areas: Roller Woods, Dickson School Nature Park or any wooded area with large trees

Equipment: Biltmore-Cruiser Stick - Optional equipment for optional follow-up activities would include equipment for measuring slope of land and increment borer

THEME: Timber, as a natural resource, can be measured in terms of economic value.

Objectives:

Calculate, by using the Biltmore stick the diameter, height, and usable board feet in a tree.

Use addition, subtraction, multiplication, division, fractions and decimals in computing the volume and value of trees.

Find the value of trees for lumber purposes.

Identify the role of forests in the interdependence of natural resources, in conserving soil, water and wildlife.

Evaluate characteristics relevant to tree growth in this forest.

PROCEDURE:

Measure the height of a tree which contains usable lumber by using the Biltmore stick and Cruiser stick. Measure maple, oak, and walnut trees.

A. Use of a Biltmore stick to find diameter:

Figuring a diameter (1) hold the stick horizontally at eye level and at arm's length from the body. (2) Line up the zero end of the stick with the left side of the tree. (3) Keeping head stationary, sight to the right edge of the tree. (4) The diameter can be read on the stick at the point where the line of vision meets the right edge of the tree.

B. Use of Cruiser stick to find height:

(1) The Cruiser stick is marked for determining the number of 16-foot logs in a tree. (2) Have students take a position for 32 paces (66 feet) from the tree to be measured. (3) Hold the stick vertically at arm's length. (4) Line up the zero end of the stick with the uppermost point of usable lumber (at the fork or where the diameter is less than 6 inches). (5) Keeping head steady, sight along scale down to the base of the tree (about a foot from the ground). Read the number of logs directly from the scale.

C. Estimating Board Foot Volume:

The preceding linear measurements are necessary for estimating board foot volume. From the diameter, height and Board Foot Volume Tables, compute the number of board feet of lumber in the tree. A board foot is a unit of volume equal in content to a board one-inch thick, one-foot wide, and one-foot long; or equaling 144 cubic inches. This unit could be: 2"x1"x72", 2"x2"x36", or any combinations of equal volume. The volume remains constant, not the dimensions. Measuring and pricing is done on a basis of thousands of board feet. The letter "M" means 1,000 board feet.

These prices were obtained from a local lumber yard to be used for comparing values of different types of trees: Maple-$930, Oak-$650, and Walnut-$1800 per 1"/1000 board feet.

Record on the data sheet the dimensions of the trees, the volume in board feet and the dollar value of computed timber volume in each tree.

Kind of Tree	Diameter	Number of 16 Feet Logs	1972 Value of 1000 Board Feet	Estimated Dollar Value of Timber In Tree
Maple			$ 930	
Walnut			$1800	
Oak			$ 650	

INTERPRETATION:

Which tree was of the most value in estimated dollars?

What are some ways in which man can conserve the source of natural building materials?

What factors are relevant to tree growth?

OPTIONAL ACTIVITIES:

Using the increment borer determine an estimate of the age of the trees in the forest. Relate the age of the trees to historical events of the area.

BOARD FOOT - VOLUME TABLE						
Diameter in Inches	Number of 16 Ft. Logs in the Tree					
	3	4	5	6	7	8
10	63	88	115	142	167	
12	97	131	174	216	255	
14	134	180	246	293	348	411
16	187	233	308	374	444	526
18		289	380	460	546	645
20		340	456	549	647	760
22			526	640	752	884
24			616	726	861	1021
26			689	840	971	1150
28			777	932	1093	1340
30				1041	1221	1444
32					1351	1600
34					1478	1743
36					1608	1887
38					1742	2031
40						2177

ENVIRONMENTAL INVESTIGATION: Forest Community Survey

Suggested Grade Level: Upper Elementary

Suggested Study Areas: Roller Woods, Dickson School Nature Park or other area with many trees

Equipment: Biltmore stick, 100 ft. tape, 5 ft. stake, Data Sheets, 52.7 foot string and eight 5 foot stakes, 5" stakes, compass, tree identification book, log scale.

THEME: Natural resources in terms of quantity and quality are important to all living things.

Objectives:

Determine the diameter of trees by using the Biltmore stick and recording the data.

Show knowledge of using a compass by setting up plots for tree surveying.

Estimate the height of trees to the first branch.

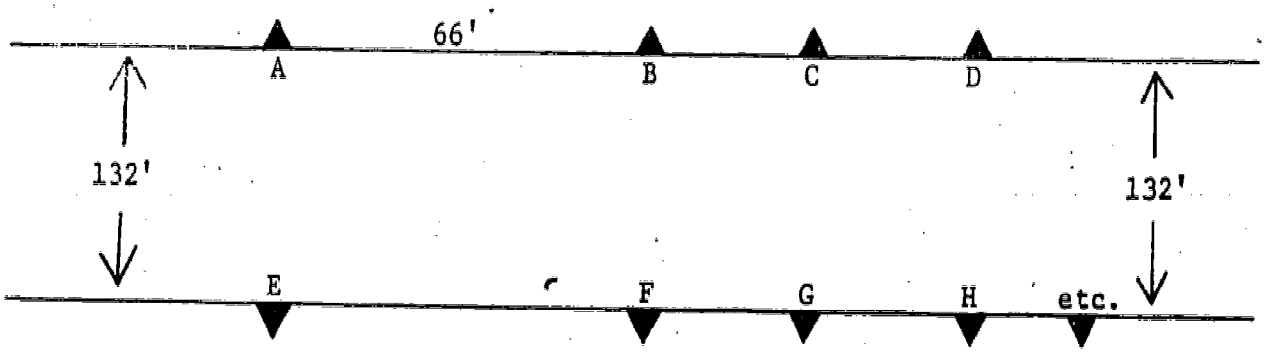
Compare sizes of different species of treen.

Discuss how well trees meet ecological needs, such as hold soil, prevent erosion, provide homes for wildlife.

Evaluate how well trees meet human needs such as physical needs, psychological needs, aesthetics, social needs, gathering places.

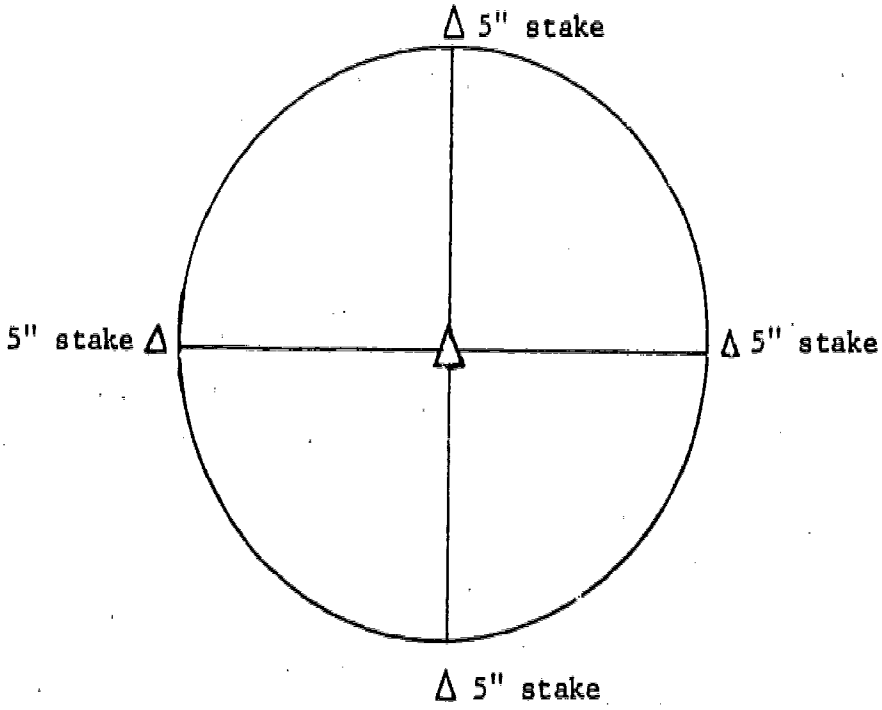
PROCEDURE:

A. Divide the class into groups on the basis of plots available. To set up plots do the following: Use a compass to get a straight line. Stake out 2 lines parallel to each other and 132 feet apart. Continue down each line driving in stakes 66 feet apart. Assign Group A to stake A, Group B to stake B, etc.



B. Individual 1/5 Acre Plot

Each group take the 52.7 foot string and attach it to the 5 foot stake. Have a student take the untied end of the string away from stake until the string is taut. Drive in one of the five-inch stakes. Repeat this procedure with the other 5-foot stakes until the 1/5 acre plot is outlined. See illustration below:



C. Survey

Using the Biltmore stick measure the diameter of trees within your 1/5 acre plot. Measure only those trees over 5 inches in diameter. Using a tape measure, measure the circumference of these trees. Estimate the height to the first branch. Record your information on the attached data sheet.

Optional Activities

1. Calculate the volume in board feet for species, plot and total area.
2. Calculate species percent.
3. Determine commercial value by species and area.
4. Determine age of a tree and trace events of history of Kingsport during the tree's life.
5. Project future growth.

DATA SHEET FOR FOREST SURVEY

Number			
Species	Diameter	Circumference	Tree Height to First Branch

INTERPRETATION:

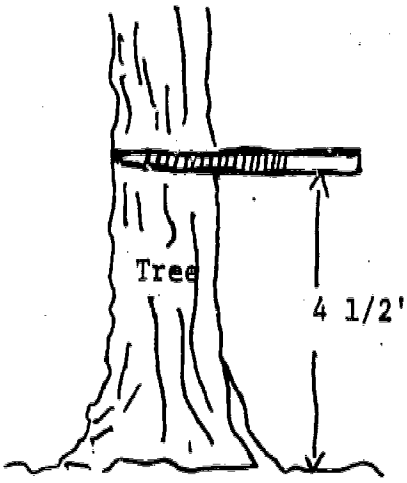
1. Plot a bar graph comparing the circumference, height, and diameter of the different species of trees.

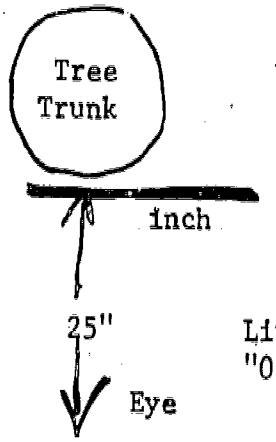
2. How do trees meet ecological needs in a natural environment? (Prevent soil erosion, provide homes for wildlife, etc.)

3. Evaluate how trees meet human needs.

The Biltmore Stick is Used to Estimate the Diameter of Trees

1. Hold the stick horizontally, about 4 1/2' from the ground.

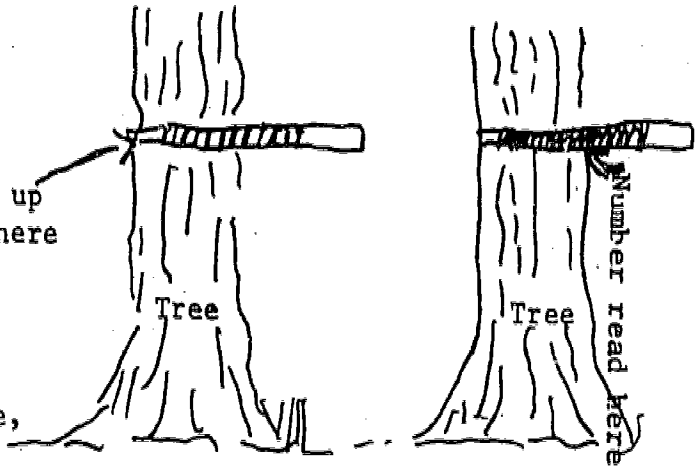




2. Hold the stick against the tree, about 25" from your eye.

3. Hold your head steady, and line the "0" up to the outside of the tree.

4. Glance at the other side of the stick. The line that lines up with the outside of the tree indicates the diameter.



REMEMBER: Do not turn your head while glancing.

ENVIRONMENTAL INVESTIGATION: Investigating Cell Structure of Plants

Suggested Grade Level: Upper Elementary

Suggested Study Area: School campus

Equipment: Microscopes, black bread mold, an onion, thick leaves (coleus, geranium)

THEME: All plants and animals are made up of various kinds of cells.

Objectives:

To investigate cell structure of plants under a microscope.

To develop an awareness of the various functions of cells in plants.

To familarize students with the concept that all living organisms are made up of cells.

PROCEDURE:

Background Information:

The physical characteristics of leaves vary greatly. Green leaves have little openings called stomata (sto-M A H-tuh). Through these openings, the leaf breathes in the gas carbon dioxide (CO_2) from the air. A green material in the leaf, chlorophyll (KLOR-uh-fil), uses the power of the sun to combine the carbon dioxide with water and minerals. (The water and minerals come in through the roots.) Out of the ingredients, a kind of sugar called glucose (GLOO-kokss) is made. The glucose dissolves in the plants sap and is carried from the leaves to other parts of the plant.

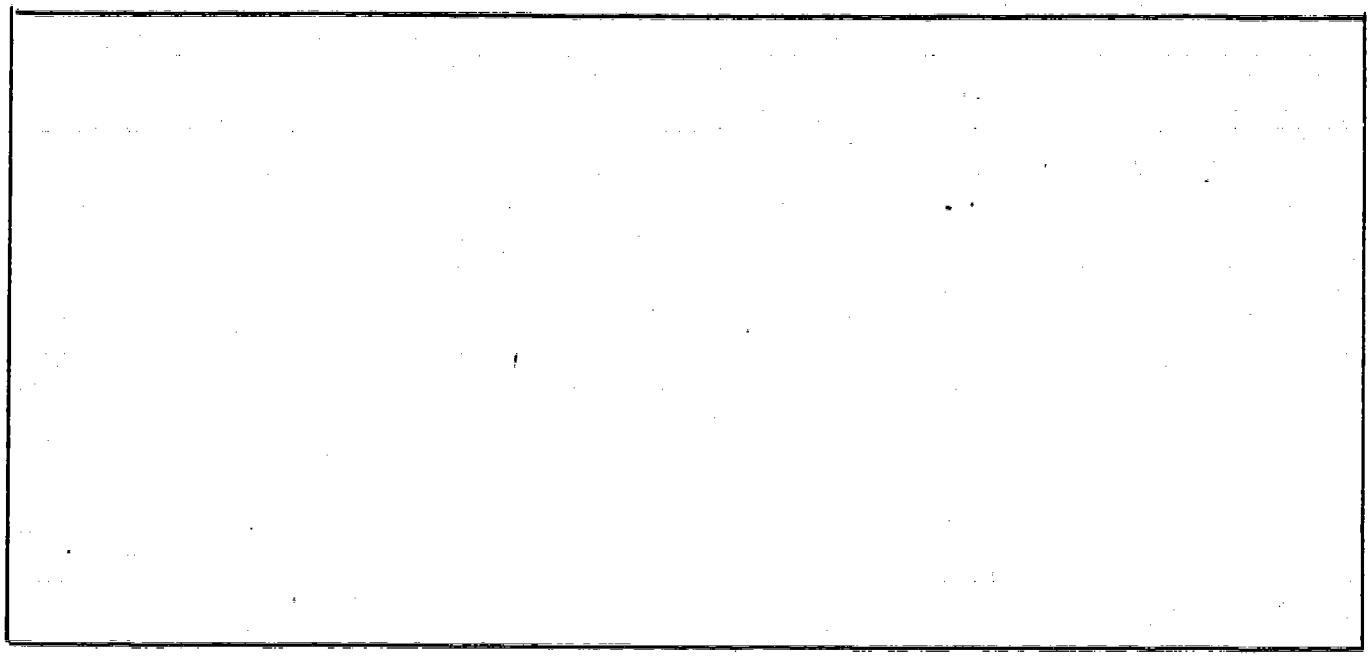
With a tooth pick take a little bit of the mold and place it on a slide. Add a drop of rubbing alcohol or water. Place a cover slip on a slide. Under the microscope you will see a network of branching threads. The threads act as roots, stems, and runners. Move the slide until a small black ball, the spore case is visable. You may find a spore case that has split, releasing tiny spores.

An onion is a good plant to look at under the microscope. The cells are easy to see and a good object on which to try staining. Cut a small square through several layers of an onion and remove them. Separate the inside. Spread out the skin on a slide, add a drop of water and a cover slip. Under the microscope you should see rows of box-like cells. Inside each cell you may see a little bubble. This is the cell nucleus. You can make it stand out more clearly by adding a drop of tincture of iodine to the edge of the cover slip. The nucleus becomes yellow, then brown but the rest of the cell remains light colored.

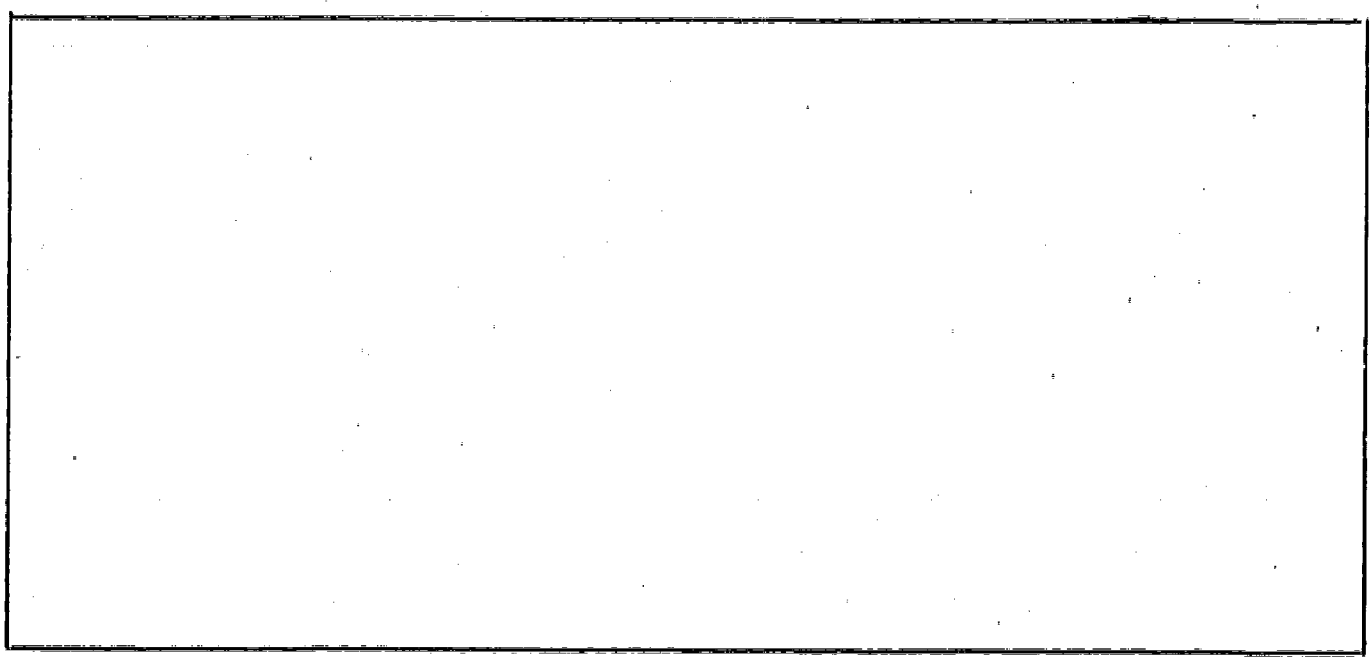
You can see other kinds of cells in the underside of a leaf. Use a thick leaf from a plant such as a geranium or a coleus. Roll the leaf between your fingers until the skin is loose. Peel off a small piece of the skin on the underside of the leaf. Mount it on a slide with a drop of water and a cover slip.

Look for a pair of bean-shaped cells surrounding a small opening. These cells are guard cells. The opening is called a stoma. The plant gives off excess water through stomata. The guard cells swell or shrink, closing or opening the stomata, depending on the amount of water that must be given off.
Make drawings of your observations.

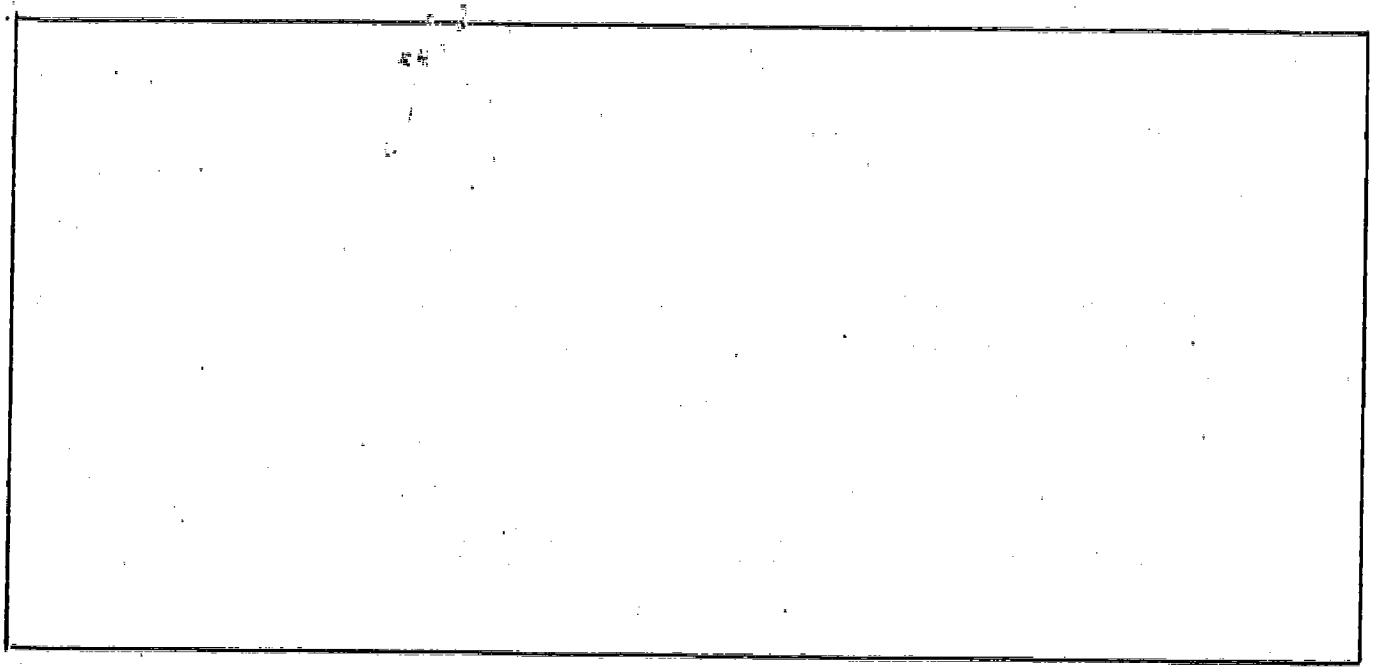
Data Sheet



Cells in the underside of a leaf. Illustrate the guard cells and stomate if you saw them.



Drawing of onion skin cells. Show the cells and cell nucleus. Color may be added to your drawing to make the nucleus stand out.



Make a drawing of bread mold showing the network of branching threads and spore cases.

INTERPRETATION:

1. What were the functions of the cells you observed in the three plants?
2. What did you notice about the shapes of the cells observed?
3. Where was the nucleus of the cell located?
4. Can you evaluate the value of the nucleus to the cell?
5. How does the cell structure of the human body compare to that of the plant?

ENVIRONMENTAL INVESTIGATION: Factors Influencing Animal Population

Suggested Grade Level: Upper Elementary

Suggested Study Areas: Marginal areas where two types of plant cover meet, where swamps meet woods, Dickson School Nature Park, Roller Woods

Equipment: Small animal traps, animal cage, burlap sacks

THEME: Every species of animal prefers a certain habitat. Survival of an organism depends upon its ability to adjust to its environment. Man changes the natural environment to the extent that many species find it difficult to adapt to the new countries.

Objectives:

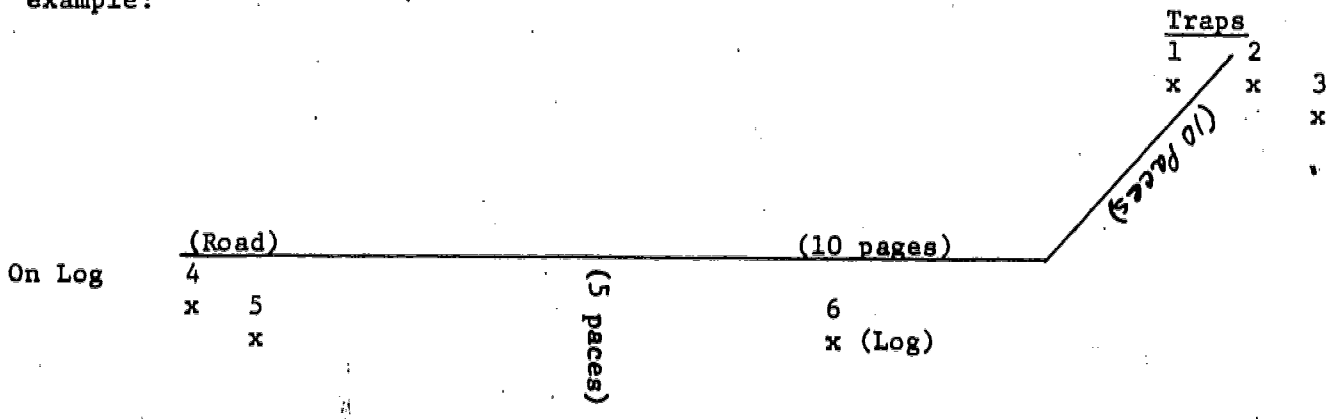
Analyze and identify man's influence on a given population.

Identify environmental factors which affect the size of a population in a given area.

Capture, observe, and discuss types of animals and animal habitats and how they are interrelated.

PROCEDURE:

Students may look for signs of animals such as burrows, runways and nestlike depressions in the grass and nutshells. Have the pupils set traps along marginal areas where two types of plant cover meet. Along these boundaries there is usually a greater variety of plants that will supply food and cover for more animals. Mark each trap area by fastening cotton or light blue cloth straps on overhanging bush, as near the trap as possible. Make a pace map of the area as you proceed. For example:



Bait the trap using a 1:1 mixture of peanut butter and oatmeal. The students may try other baits such as: strawberries, bacon, smoked herring, or raisins. Throw a small amount of bait at the entrance of the trap to attract animals. Place some cotton or dry grass inside the trap to provide nesting material for the trapped animal; and finally, place the trap in the chosen location. It is advisable to have the students describe the placement of their trapping devices with their pace maps. This may be accomplished by describing the trap locations by means of identifying land marks. For example:

Area A - shrubbery area with deep-litter near a fallen log, 25 paces west of the fork in the main road

Trap 1 - at uprooted end of the fallen log, baited with oatmeal

Trap 2 - set alongside of log, baited with peanut butter

Trap 3 - set on opposite side of log from Trap 1, baited with mixture

Establish a reference point between two areas.

Area B - in a grove of alder, 50 paces due south of Area A

Trap 4 - set directly at burrow entrance, baited with peanut butter

Trap 5 - set at definite animal runway, under small fallen log near burrow entrance, baited with 1:1 peanut butter-oatmeal mixture

The next morning, examine the traps and record findings on data sheet. If an animal is caught, slip a burlap bag over the trap. Open the trap inside the sack, gently shake the animal out and then transfer it from the sack to a cage. These mammals may be observed for study, then released in the same area where they were caught when everyone has had a chance to observe them.

DATA SHEET FOR TRAPPING ANIMALS

Trap Number	Habitat Description	Bait	Result	Temperature	
				Night	Morning

1. How many animals were caught?_____

2. What were the animals?_____

3. On what part of the site did you have the most trapping success?

4. What did you learn about these mammals that you did not realize before trapping them?

5. Describe the weather conditions from the time you set the traps until you checked them? What affect did this have on the success of your study?

6. Were there any evidences of man's interference in the study area?

ENVIRONMENTAL INVESTIGATION: Insect Adaptations

Suggested Grade Level: Upper Elementary

Suggested Study Areas: School campus, Dickson School, Nature Study Area, Bays Mountain, Allandale Farm

Equipment: Golden Nature Books, a killing jar, collection boxes, insect nets, an aspirator, hand lens, light forceps, vials filled with 80% alcohol for killing, a box sieve.

THEME: Interrelationships and interdependencies exist between man and the many varieties of living organisms.

Objectives:

Examine and analyze the many varieties of insects.

Develop skills in collecting, preserving, and identifying insects.

Identify individual characteristics which help them adapt to their environment.

Recognize the ways in which man and insects are interrelated.

Record your information on the attached data sheet.

INTERPRETATION:

1. Based on the results of your investigation, how do color and size determine where an insect lives?

2. What are the relationships between the way an insect moves and his means of protection?

3. How are insects useful to man?

4. How has commercial, industrial, and residential development affected insect habitat?

Optional Activity:

1. Hidden Insect Discovery Game:

   See if the children can find the 21 insect names hidden here.

W	O	S	H	P	A
M	A	T	I	N	G
U	N	Y	D	B	U
A	L	F	E	T	M
E	C	I	R	L	B
K	T	M	C	O	

   Start with any letter and move in any direction (up, down, across, or diagonally) to spell the insect's name. No box may be skipped, but a letter may be repeated as often as needed. Some of the names are two-word names. In each of these cases, the box of the last letter of the first word touches the box of the first letter of the second word. Answers: fly, ant, bee cricket, bedbug, butterfly, luna moth, flea, bumblebee, aphid, mantid, tumblebug, borer, termite, lice, mayfly, bee fly, firefly, deer fly, beetle, assassin bug.

2. Use a live cricket for study. The chirping of a cricket is a fairly accurate indicator of the air temperature. This can be done by counting the number of chirps in 15 seconds and then adding to 40. The sum is the approximate air temperature in degrees F.

DATA SHEET

Name or Drawing of Insect	Size	Color	Type of Mouth Part	How He Moves	Protection	Where He Lives	Uses To Man	Other Identifying Characteristics

ENVIRONMENTAL INVESTIGATION: Recognizing Birds by Sound and by Sight

Suggested Grade Level: Upper Elementary

Suggested Study Areas: School campus, Dickson School Nature Park, Roller Woods, other areas with trees, swamps, cleared areas, advanced second growth woods.

Equipment: Golden Nature Guide to Birds, binoculars, tape recorder, Bird List Data Sheet for Students.

THEME: Living things are interdependent with one another and with their environment. Birds are vertebrates that have specialized adaptations for enabling them to master their land, air and water environments.

Objectives:

Make careful written observations about special characteristics of common birds.

Analyze those body structures of birds which help them adapt to their environment.

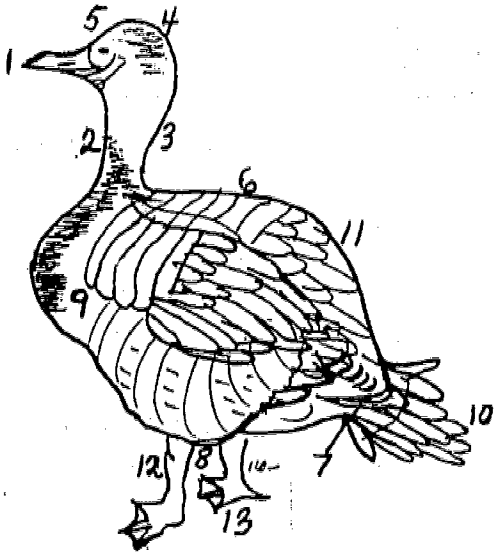
Recognize some common birds by sight and by sound.

Draw conclusions that man is dependent upon birds as a necessary component for environmental ecological balance, for food, and for pleasure.

PROCEDURE:

This field experience should be preceded by teachers acquainting students with general bird anatomy that is important in identification. Recordings of bird calls can be used.

Acquaint intermediate students with the following body characteristics of birds that they will observe in field study.



Field study will teach pupils to observe:

1. Beak
2. Throat
3. Nape
4. Crown
5. Eye Color
6. Back
7. Rump
8. Bell
9. Breast
10. Tail
11. Wings
12. Legs
13. Feet

Choose suitable site for bird study. Using binoculars observe as many birds in various habitats as possible.

Record your findings on the attached data sheet.

A tape recorder may be used to record various bird sounds.

Optional Activities:

1. Classify birds seen at the site by means of their beaks.
2. Have students pool all of their observations on charts.
3. Compare recorded tapes with commercial recordings.
4. Mount any feathers found on cardboard sheets. Be on lookout for the four main types of feathers - wing flight feathers, tail feathers, converts, and down.

INTERPRETATION:

1. What body structure of birds did you identify that helped them adapt to their environment?
2. Plot a graph comparing the numbers of each species found.
3. What are some ways birds help meet the ecological needs in the natural environment?
4. How has man influenced the environment and ecological balance of birds?

DATA SHEET

Name_____ Date_____ Time_____

Weather Conditions_____

Name	What It Was Doing	Number Seen	Special Characteristics	Where Seen

ENVIRONMENTAL INVESTIGATION: Collecting Microscopic Soil Animals

Suggested Grade Level: Upper Elementary

Suggested Study Areas: School campus, Dickson School's Nature Park, Roller Woods

THEME: Animals and Their Function in A Community

Objectives:

Compare the number of microscopic organisms found in 2 communities.

Develop an awareness of diversity and variations of microscopic organisms in the soil.

Compare and relate the role of microscopic soil organisms in decomposition to man's need for recycling.

PROCEDURE:

Collect soil and leaf litter samples from which minute animals may be extracted. Make sure these samples are from different plant communities (tree, grass, shrub, etc.). Cut a core sample of the soil to a depth of 8-10 cm. (approximately 4-5 inches). Core can be conveniently taken with a small orange juice can. Take at least two samples of soil from each plant community. Place each sample in a small plastic bag for transportation to the laboratory. Each bag should be labeled with the specimen soil type (surface-litter and sub surface). Place each sample in a funnel containing a small piece of steel wool with the neck of the funnel suspended just above a small container of 5% formalin. The steel wool in the bottom of the funnel will hold back the litter and soil but the bottom of the funnel will hold back the litter and soil but will allow the small organisms to pass through. Above the funnel a small light bulb should be fixed several inches from the sample material. This light and heat, with the subsequent evaporation of moisture from the soil, forces many of the organisms in the samples to move downward into the preservative. This method is especially satisfactory for the collection of mites and small insects. (It should be noted that after the soils have been heated for about seven days there is little likelihood that any more animals will be found for several weeks.)

Once the animals have been collected, examine them under low power of compound microscopes.

Using the attached data sheet, record your findings.

DATA SHEET

Soil Surface (Litter)	Community	Kinds of Animals Found (Name or Draw A Picture)	Number Found
	Trees		
	Grass		
	Shrub		

Sub Surface	Community	Kinds of Animals Found (Name or Draw A Picture)	Number Found

Total the number of each species found.
Record the totals on the back of this sheet in descending order of abundance (from the most abundant to the least abundant).

INTERPRETATION:

1. Plot 2 graphs showing a comparison of the number of organisms taken from the different plant communities. One graph should show surface litter comparisons and the other sub-surface comparisons.

2. List some of the likenesses and differences of the animals you observed.

3. How would you compare the role of microscopic soil organisms in decomposition to man's need for recycling.

ENVIRONMENTAL INVESTIGATION: Influence of Algae in an Aquatic Community

Suggested Grade Level: Secondary

Suggested Study Area: Dickson Nature Park, Roller Woods, Allendale Farm, Mad Branch Stream, Bays Mountain

Equipment: Environmental Microbiology Kit

THEME: Through the analysis of alga, much information can be obtained about the interrelationship in an aquatic environment.

Objectives:

To identify variations in algae populations as a means of indicating the condition.

To perform pigment analysis investigations in order to help determine the density of algae growth.

To examine the algae population found in a healthy ecoscystem.

PROCEDURE:

A. Collecting Samples

In performing the investigation on alga analysis, one suggested procedure would be to divide the class into 3 groups each group conducting one of the following investigations; (1) pigment analysis, (2) counting alga populations, (3) identifying polluted water algae. Each group could then rotate and complete all of the investigations.

From the microbiology kit, obtain smooth tipped forceps, and load the Sterifil holder with a type HA fileter.

Add 250 ml of water (the calibrated Sterifil funnel facilitates measuring sample volume).

Using the Hand Vacuum Assembly, obtain a sample of water by applying a vacuum with a few strokes. The water sample will flow through the filter leaving the algae cells trapped on the filter surface.

When filtration is complete, release the vacuum and set the filter down on a clean surface to dry.

The dried filters can now be stored in a 47 mm Petri dish or mounted on a chart along with other sample filters for comparison.

B. Pigment Anlysis

Using the procedure as in activity one, collect a sample size of algae that will produce a heavy deposit on the filter without clogging it.

Drop the test filter into a beaker containing 10 ml of a solution that consists of 90% acetone and 10% methyl alcohol. The filter will dissolve, leaving the algae pigment (chlorophyll A) in solution.

Transfer this to a test tube and compare the color with other similarly prepared slides.

C. Counting Algae Population.

Scientific studies have shown that algae populations in excess of 1000 per ml give evidence of over enrichment resulting from sewage or other nutrients. The following procedure should help students determine the number of algae in a given sample.

Collect and filter a sample of pond water as done in activity one and two. If the water contains an abundance of algae, it will be necessary to use a smaller size, say 10 to 50 ml. Be sure to record the sample volume used.

When filtration is complete, release the vacuum and test filter down to dry on a clean surface for about 30 minutes. If an overn is used, the process can be done quickly.

Put about 5 ml of microscope immersion oil in a 47 mm petri dish or a watch glass. Pick up the dry filter with a smooth-tip forceps and float it on the immersion oil. If the filter is completely dry, it will immediately become transparent, as its pores become filled with oil of matching refracture index. If the filter remains opaque, there is still some water in the pore structure. Place the Petri dish and filter on a warm surface until the filter clears.

Draw the filter across the edge of the Petri dish to remove excess oil.

Now center the filter on a 2" by 3" microscope slide. Place the slide on the stage of a microscope and using a reflecting mirror or light source from below the stage , scan the filter surface at low magnification (10 x 40X)

Count the number of algae in each of ten selected fields in the filter. Calculate the number of algae in the original sample by using the following formulas:

$$\frac{1380\ (mm^2)}{\text{area of field } (mm^2)} \quad X \text{ No. of fields counted} = \text{factor}$$

$$\text{Total No. of Algae counted} \quad X \text{ Factor} = \text{No. of Algae in sample}$$

The value of 1380 mm^2 is the total filtration area of a 47 mm membrane filter when used in a Steriff filter holder. This value will vary from other types of filter holders. The area of the field is a variable that must be calculated for individual microscopes It can be determined with the aid of a stage micrometer or simply by laying a transparent plastic rule across the diameter of the field view.

The area of the circle is calculated by using the formula πr^2. This procedure may be used for low or high power objectives.

Having calculated the number of algae cells in the sample and knowing the volume of the sample that was filtered, you can calculate the number of algae per ml by using the following formula:

$$\frac{\text{No. of algae in sample}}{\text{Vol of sample (ml)}} = \text{No. of algae per ml.}$$

For example, you have filtered a sample of 50 ml of pond water. After drying and cleaning the filter with immission oil, you have analyzed the filter microscopically at 100 X magnification, determining that the area of a field at 100 X is 5 mm^2. If you pick 10 fields at random and count a total of 55 algae cells, your calculations should be:

$$\frac{1380}{5} \times 10 = 2760$$

$$55 \times 2760 = \text{151,800 algae in original sample of 50 ml}$$

$$\frac{151,800}{50} = \text{approximately 3,000 algae per ml}$$

D. Identifying Polluted-Water Algae.

In addition to the number of algae, another indication of water quality is the types of algae found. For example, where water is polluted there is a sharp decline in the number of green algae and diatoms, and an increase in the number of blue-green algae and flagellates. High magnification (100 X) can be used to identify the various algae collected on the filter surface. Table 1 of this activity gives the major characteristics of each group.

Record the number of each of the algae groups seen per grid square. Use the formulas given in the last activity to determine the relative numbers of each group. Is there a healthy species diversity indicating clean water or is there a predominance of blue-green algae which indicates pollution?

TABLE I. Algae Characteristics

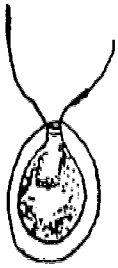
Characteristics	Blue-Green Algae	Green Algae	Diatoms	Flagellates
Color	Blue-Green to Brown	Green to Yellow Green	Brown to Light Green	Green or Brown
Cell Wall	Not Distinguishable	Distinguishable	Very distinguishable with regular markings	Sometimes distinguishable
Nucleus	Absent	Present	Present	Present
Flagellum (tail)	Absent	Absent	Absent	Present

Data Sheet - Analysis of Algae

Kind of Algae	Name of Algae	Dominant Color	Volume of Sample Used	Number of Algae in Sample	No. of Algae Per ml.	No. of Algae groups per grid square

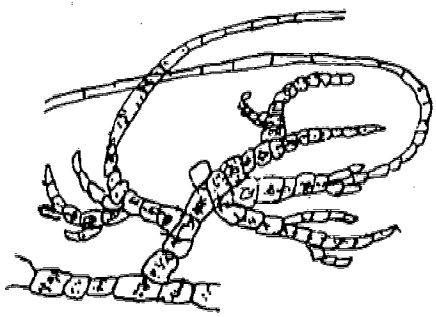
SOME COMMON ORGANISMS

Zygnema



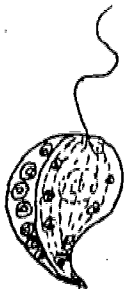
Chlamydomonas

Closterium

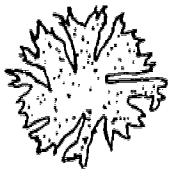


Chaetophora

Anabaena



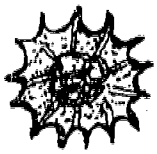
Phacus



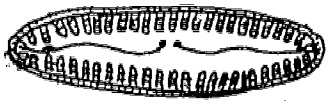
Micrasterium

Stigeoclonium

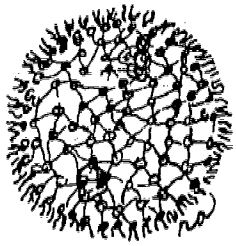
Spirogyra



Pediastrum

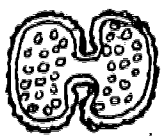


Pinnularia



Volvox

Fragilaria



Cosmarium

Oscillatoria

INTERPRETATION:

1. How does the algae population affect the purity of a water supply system?

2. Do you think algae is more beneficial to man than it is harmful?

3. What future role does algae have in man's conquest of space?

ENVIRONMENTAL INVESTIGATION: Bell-shaped Distribution of Variation in Demes

Suggested Grade Level: Secondary

Suggested Study Areas: Bays Mountain, Roller Woods, Dickson School Nature Study Area

Equipment: Collecting jars, graph paper, notebook, live animal traps, butterfly nets

THEME: Diversity begins at the lowest level, with the frequently mentioned fact that no two individuals are ever exactly alike. No matter how small a unit of population, there is always variation among its members. Within a population, the variation arises mainly from the shuffling of genes and chromosomes, especially in sexual reproduction.

Objectives:

To investigate variations in natural populations.

To observe various characteristics of organisms and tabulate them in the form of a frequency distribution.

To recognize that factors affecting natural populations may also affect human population.

PROCEDURE:

A. Collection, Observation and Examination of Specimens from one Deme.
Examine from 50 to 100 specimens from one deme of some sort of organism. If the specimens are collected in a limited area and over a brief period of time they can be considered from a single deme. Among the innumerable possibilities are flowers, leaves (full-grown, each from a different plant of one species, or mature leaves from a single plant); seeds, shells, ants, grasshoppers, beetles, butterflies, or other insects; or field mice, scales on snakes. Whatever is collected some measurement of size will be possible. Probably also there are characters that can be counted (petals on a flower, scales of a pine cone, ribs on a shell, etc).

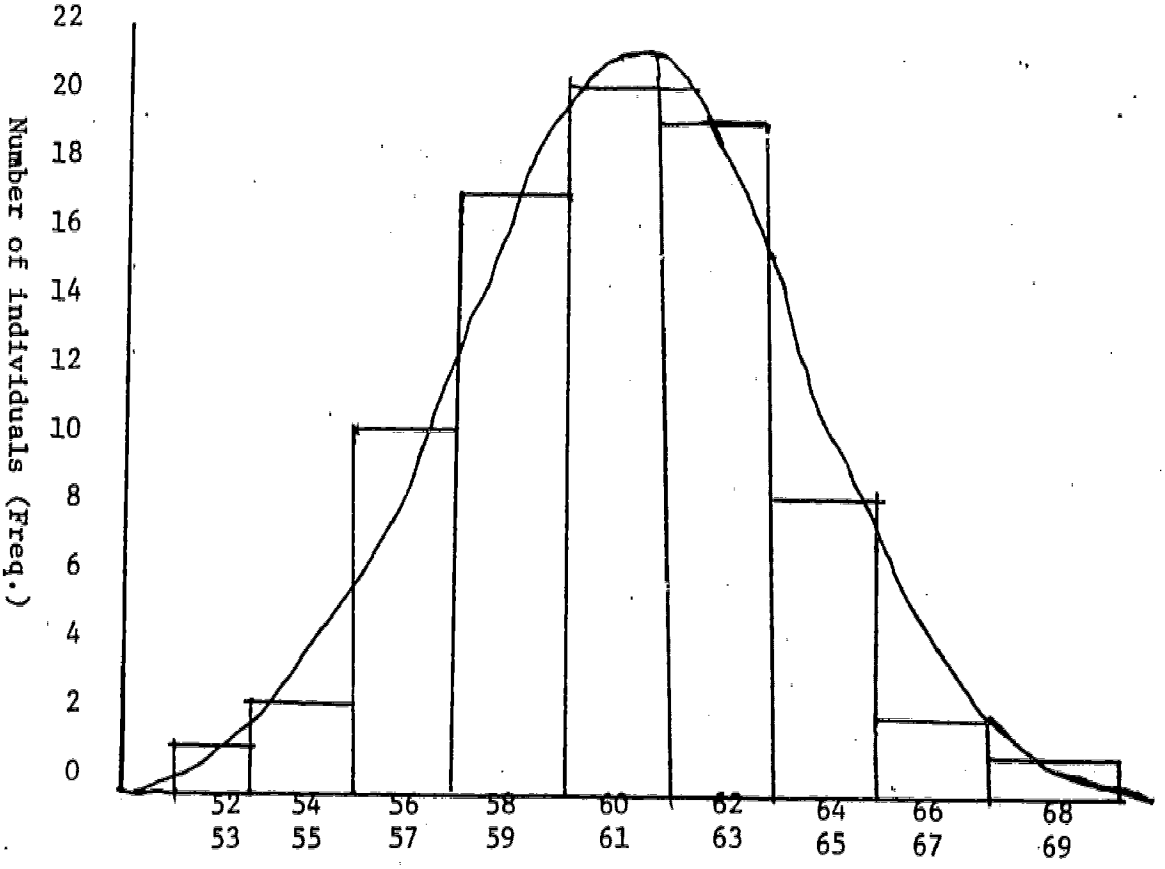
B. Forming a Frequency Distribution.
In the sample some features will be the same in all individuals. It is characteristic of a deme that the organisms in it are similar. For instance if simple flowers are collected, all will probably have the same number of petals, although they may not. Other characters are sure to vary in the sample. This is especially true of measurements of size and weight or of counts of multiple parts as ribs on a shell or scales on a snake. After carefully observing such characters, group and tabulate them in the form of a frequency distribution.

An example of a frequency distribution is given below:

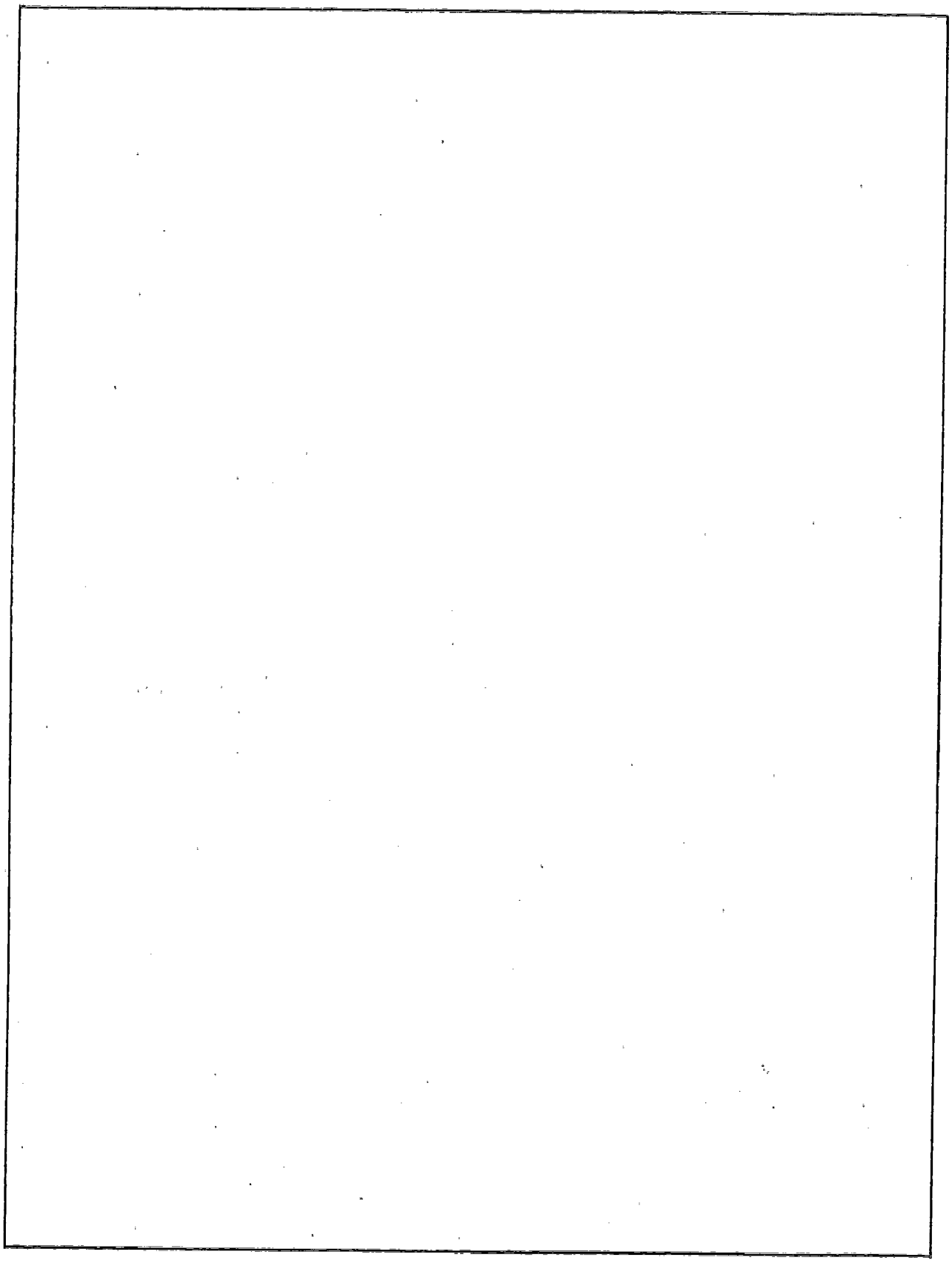
Tail length of individuals from a deme of Deer Mice.

Measurement in Millimeters	Numbers of Individuals (Frequency)
52 - 53	1
54 - 55	3
56 - 57	11
58 - 59	18
60 - 61	21
62 - 63	20
64 - 65	9
66 - 67	2
68 - 69	1

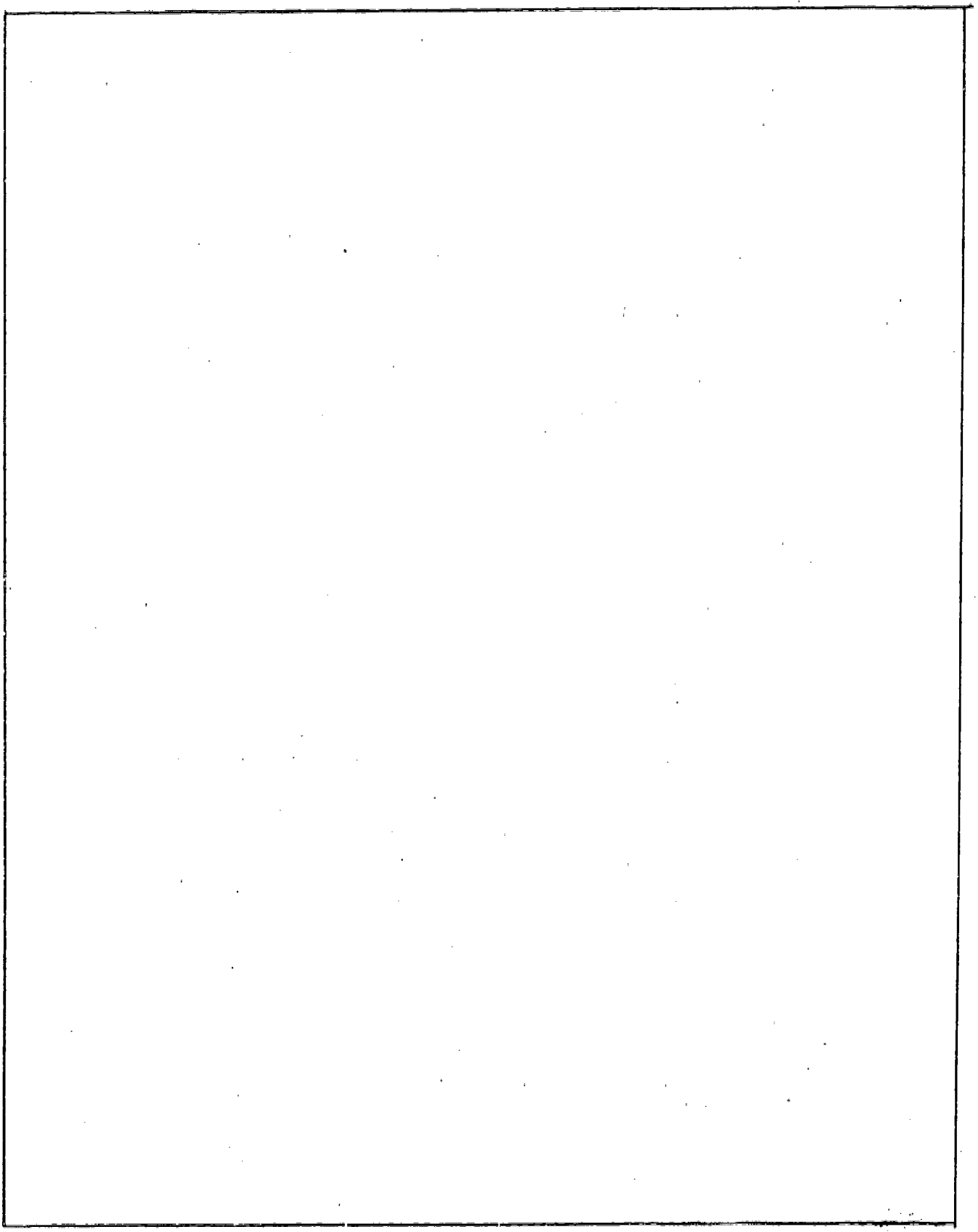
C. Preparation of graphs from frequency distributions.
Using the information tabulated in the frequency distribution prepare a graph to present pictorially the bell-shaped distribution of variation in a deme.
The graph may look something like the illustration below.



Data Sheet for Frequency Distribution



Data Sheet for Graph



INTERPRETATION:

After tabulation and graphing is complete answer the following questions:

1. Define mode. What is the mode of your sample?

2. Look at the graph and explain what happens to the frequencies on each side of the mode.

3. What kind of curve does the pattern as illustrated by the graph, present?

4. If a pattern is established, what does it mean biologically?

5. From what two things may variation result? Explain

6. From your investigation of variations in natural population, what environmental factor did you identify that also affects human population?

Suggested Grade Level: Secondary

Suggested Study Areas: School Campus

Equipment: Budding and grafting knife, pruning shear, rubber band or twine

THEME: Grafting is the act of making contact between the cambium layers of two stems in such a manner that they will knit and grow together.

Objectives:

To describe how to make a simple bud graft

To observe how stem grafting is done

PROCEUDRE:

A bud is cut from a twig in the shape of a shield, starting the knife blade about 1/2 inch above the bud, cutting deeply enough into the twig to avoid injury to the bud and coming out again about 1/2 inch below the bud. A T-shaped cut is then made in the bark of the young tree to be budded. If the bark does not raise up easily enough to admit the bud without injury, the edges must be loosened with the point of the knife blade. The bud is inserted into the T-shaped opening, and pushed downward into place. It is held in place with a rubber band or twine.

In about two weeks the binding can be loosened. If the bud knits and grows, in the following spring the stock must be cut immediately above the new bud.

INTERPRETATION:

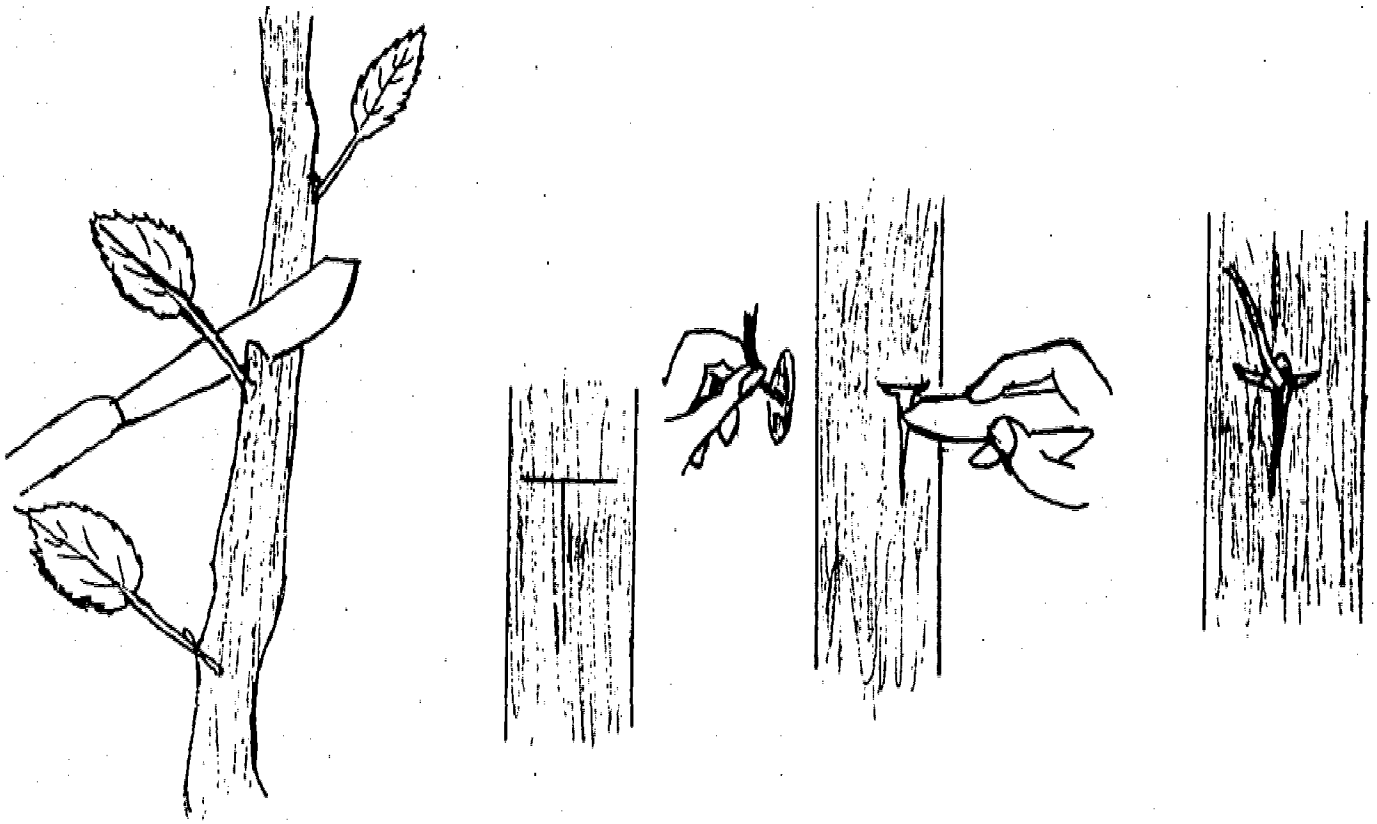
Label the diagrams on the following page using these names; bud-cion, stock, T-shaped cut; bud in place; bud after wrapping, new branch from bud.

1. Why do the stems, leaves, flowers, fruits, and seeds eventually produced from the cions or buds have characteristics of the parent of the cions or buds and not of the stock?

2. How is the cion influenced by the stock?

3. How can several varieties of fruit be developed on the same tree?

HOW BUD GRAFTING IS DONE



HOW STEM GRAFTING IS DONE

ENVIRONMENTAL INVESTIGATION: Vegetation Analysis: An Introduction to the Line Intercept Technique

Suggested Grade Level: Secondary

Suggested Study Area: Bays Mountain, Roller Woods, Dickson School Nature Study Area

Equipment: Meter sticks or yard sticks or short tape measures, stakes, notebook, identification keys

THEME: In an effort to understand our natural environment, ecologists are devising and using means to make quantative studies. A great deal of information about the interdependence of living things can be obtained from data on the numbers, linear extent, and frequency of occurance of individuals of different species intercepted by a series of line transects through the stand.

Objectives:

To teach the student some standard vegetational measurements.

To observe, collect, and interpret data.

To develop an awareness of the precarious ecological situation of the earth today.

PROCEDURE:

Determine the number of line transects to be run. Using a transect line of heavy twine or light weight rope - 100 ft. in length, marked off in intervals of 10 feet, lay out the line transect. Meter sticks, yard sticks or a short tape measure will be needed to measure the length of transect segments intercepted by individual plants for the determination of frequency.

Record only those plants that are touched by the transect line or that underlie or overlie the transect line. Measurements of the lengths of the transect line intercepted by individual plants may be recorded in Table I. Data for different transect intervals should be recorded in different columns. The intercept distance is the distance from the interval mark on the transect line to the intercept plant in a particular interval.

In summarizing the data, the total number of individuals of each species, the total of intercept lengths for each species, and the number of transect intervals in which each species occured should be determined and entered in Table II. From this information complete Table II using the following formulas:

$$\text{relative density} = \frac{\text{Total individuals of a species}}{\text{Total individuals of all species}} \times 100$$

$$\text{dominance or cover} = \frac{\text{total of intercept lenghts for a species}}{\text{total transect lengths}} \times 100$$

$$\text{relative dominance} = \frac{\text{total of intercept lenghts for a species}}{\text{total of intercept lengths for all species}} \times 100$$

$$\text{relative frequency} = \frac{\text{frequency value for a species}}{\text{total of frequency values for all species}} \times 100$$

$$\text{importance value} = \text{relative density} + \text{relative dominance} + \text{relative frequency}$$

TABLE I

Intercept Distance for Different Species in Intervals of Eaual Lengths Along a Transect Line

Species	Interval No.____	Interval No.____	Interval No.____	Interval No.____	Interval No.____	Interval No.____	Interval No.____	Interval No.____	Interval No.____	Interval No.____	Total Intercept Length
	Inter-cept Distance	Inter-cept Distance	Inter-cept Distance	Inter-cept Distance	Inter-cept Distance	Inter-cept Distance	Inter-cept Distance	Inter-cept Distance	Inter-cept Distance	Inter-cept Distance	

TABLE II

Summary of Vegetational Measurements

Species	Total Individuals	Total Intercept Length	Inter-Vals in which recorded	Relative Density	Dominance	Relative Dominance	Frequency	Relative Frequency	Importance Value
Total									

INTERPRETATION:

1. Were some plants more numerous than others? Which ones?
2. What are some factors which may determine which will be the dominant plant?
3. In what vegetation types would a transect analysis probably be most efficient?
4. Of what value are quantitative studies of vegetation to the ecologist?
5. To what degree has man's activities influenced the outcome of the transect analysis?

ENVIRONMENTAL INVESTIGATION: Field Analysis Of Bryophytes

Suggested Grade Level: Secondary

Suggested Study Area: Dickson School Nature Study Area, Roller Woods, Bays Mountain

Equipment: Compound Micrsocope, slides, cover glasses, hand lens, small paper sacks, forceps, dissecting needles, dissecting microscope, notebook, taxonomic keys to the mosses

THEME: The mosses are found throughout the world. Variations in life cycle, size, and color have adapted them to many different habitats. They grow on trees, rocks, ravines, shaded hillsides, and decaying stumps and logs; in loose sand, open fields, and among the leaf litter of the forest floor, and along the banks of streams.

Objectives:

To formulate hypothesis concerning the role of mosses.

To familiarize students with the probable first kind of plants to invade the land on the evolutionary scale.

To identify and examine the gametophyte and sporophyte generations of moss plants in their native habitats.

To become familiar with the use of taxonomic keys.

To gain a better understanding of the ecology, morphology and taxonomy of the mosses.

PROCEDURE:

A. Collection and Identification of Mosses.
Look everywhere there is reduced light and moisture. Collect good shoots bearing stalks, capules rhizoids. Put the specimens in different numbered bags, and record the location, date and substratum on the data sheet. Use identification keys to trace your specimens to their particular genus.

Specimen Number	Location	Date	Substratum	Genus

B. Study of moss gametophyte and sporophyte plants. The familiar clump of green moss plants are the leafy shoots, or gametophyte generation. They may appear to have a stem and roots, but these are not considered as such because they lack the vascular tissues found in higher plants. Examine the leafy shoot and locate the slender, rootlike structures at the base. These are the rhizoids. Do they appear to branch?_____
Put a section of the rhizoid on a slide and prepare a wet mount. Examine under high power of your microscope. Do you find chloroplasts?_____
What color is the rhizoid?_____
Examine the stem axis and the leaves it bears. Describe the arrangement of leaves on the axis._____

_____

Remove a leaf and prepare a wet mount. Examine with low power. Describe the arrangement of the cells._____

_____

Look for the chloroplasts. How are they arranged in the cells?_____

_____

Gamete-producing organs are borne at the tips of the leafy shoots in a cluster of leaves. Certain shoots bear archegonia, containing eggs. Others bear antheridia, which produce sperms. Examine the tips of several leafy shoots with a hand lens and see if you can find these sexual reproductive organs. If possible, locate the stalked, club shaped antheridia at the apex of the leaf stems. Remove a portion of the apex, put it on a slide, and using a dissecting needle, macerate the material to free the sperms. Put a drop of water and a cover glass over the material. Examine under low and high power. Do you find any sperms?_____If so describe them._____

_____

Locate the flask-shaped archegonia. Remove and prepare a wet mount of several archegonia. Examine under low power and locate the egg cells. Describe the egg cells._____

_____

Examine a leafy shoot bearing a stalk and capsule at the tip. This is a second moss plant, known as the sporophyte generation. It consists of a slender stalk, or seta, which terminates in a capsule. Why are these sporophyte stages present only on certain leafy shoots?_____

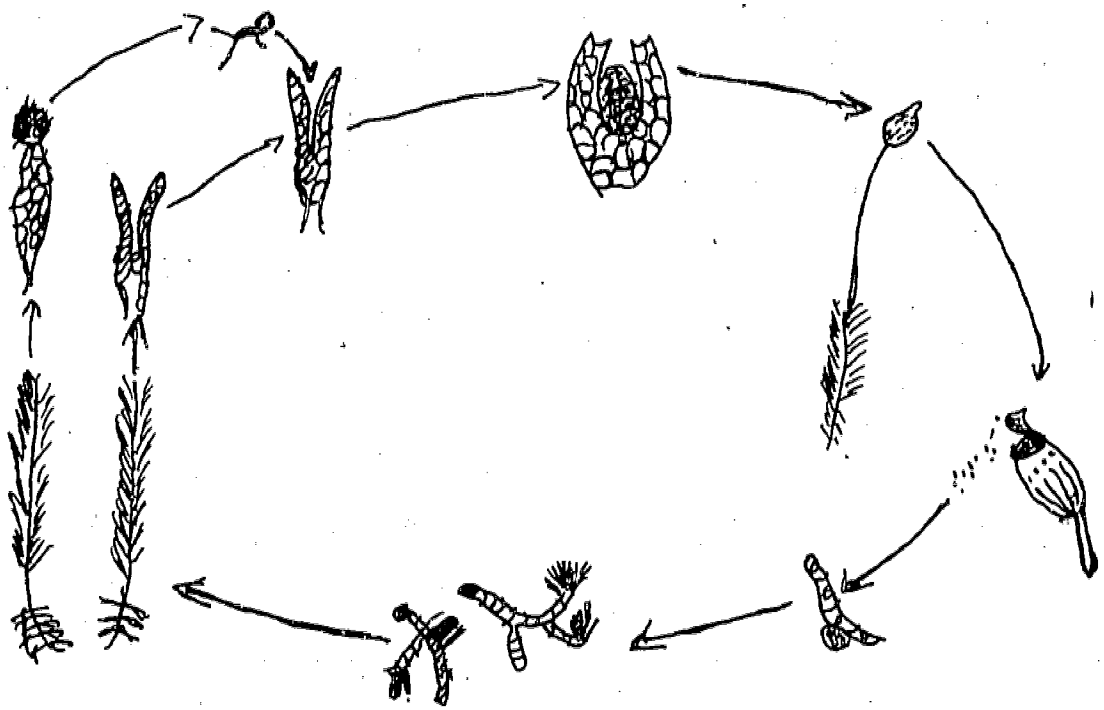
_____

Examine the capsule closely with a hand lens or dissecting scope. In some species a pointed hood, or calyptra, covers the capsule. Is a calyptra present on your specimen? If so, remove it with forceps. Turn the tip of the capsule toward you and examine with a hand lens. Is a tiny lid or operculum, covering the end of the capsule?_____This structure falls away when the capsule ripens and dries. If it is present, remove it carefully with forceps. This should expose a ring of teeth through which spores sift when the capsule is mature. If the capsule of your specimen is discharging spores, dust some on a drop of water on a micrsocope slide and add a cover glass. Examine with high power. Draw several spores in the space provided.

Spores (High Power)

C. Life Cycle of a Moss.

Examine the stages in the life cycle of the moss shown in the diagram. The stages progress clockwise in the figure. Label each stage of the cycle and indicate whether it is a gametophyte or sporophyte and whether it has an N or 2N chromosome content.



INTERPRETATION:

1. Discuss how certain parts of the moss plant suggest a possible evolutionary relationship to certain algae.

2. What is alternation of generations?

3. Discuss why mosses have become an insignificant part of the flora?

4. Why are mosses unable to compete with the more highly developed flowering plants?

ENVIRONMENTAL INVESTIGATION: Field Analysis of Ferns

Suggested Grade Level: Secondary

Suggested Study Areas: Bays Mountain, Dickson School Nature Study Area, Roller Woods

Equipment: Large book or magazine for collecting fern fronds, hand lens, field notebook, taxonomic key to the ferns, microscope, slides, cover glasses, dissecting needles, glycerin

THEME: Ferns, like mosses are distributed throughout the world and in many habitats. They are found in woodlands, moist meadows, along roadsides and stream banks. They vary in size from the tiny floating ferns to the giant tropical tree ferns.

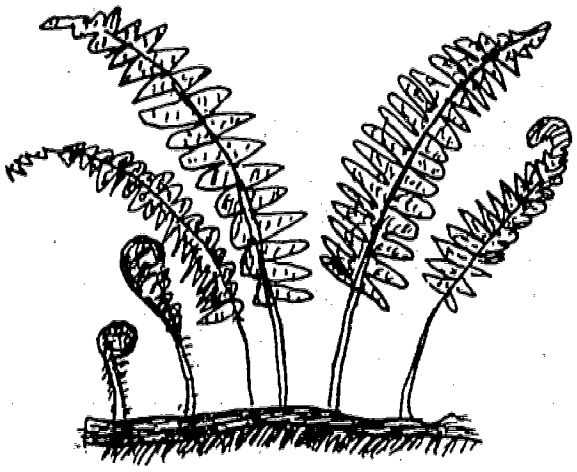
Objectives:

1. To examine and identify non-seed bearing vascular plants or our region.
2. To determine the various habitats in which ferns live.
3. To compare and contrast evolutionary trends of plants from algae to the ferns.

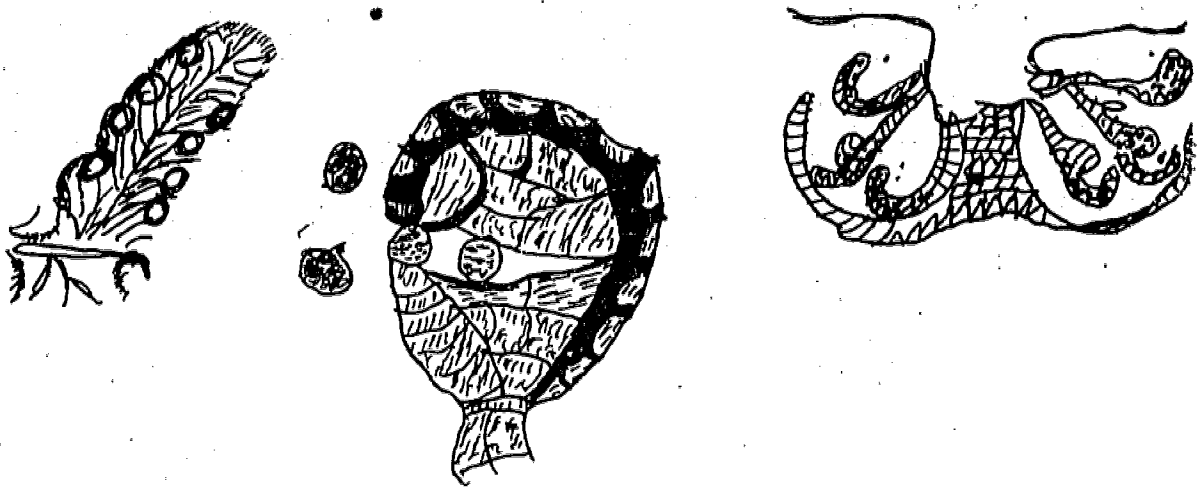
PROCEDURE:

A. Study of the Fern Sporophyte Plant.
The familiar fern plant is the spore-producing stage. This conspicuous sporophyte generation is not attached to the gametophyte generation, as it is in the mosses.
Remove an entire sporphyte fern plant and wash the soil from the roots. Observe the horizontal underground stem, roots, and leaves. The stem or rhizome, is horizontal and grows just beneath the surface of the ground. Roots emerge along the rhizome. Leaves, or fronds, grow at intervals along the rhizome. The young frond pushes through the soil as a "fiddle-neck". As it grows, it unrolls. A mature frond consists of a stalk, or seta, and a blade that is divided into leaflets, or pinnae. At maturity, certain of the fronds bear fruit does, or sori, on the lower surface of the pinnae. These are the fertile fronds. A sorus consists of a cluster of sporangia in which spores are porduced.

In the drawing label: Rhizome, roots, fiddleneck, seta, pinna, sorus.



Using a fern fron bearing sori, examine a single pinna with a hand lens. Note the structure of the blades and location and number of sori. In many ferns, a membranous indusium covers the cluster of sporangia in a sorus.
Depending on the species, the indusium may be heartshaped, circular, cup shaped, or elongated. In some species, such a polypodium, the indusium is lacking.
Scrape several sporangia from a sorus on your fern and examine under low power of your microscope.
Notice that the sporangia resemble a helmet from a suit of armor. Find the stalk attaching the spronagium and the thin walled lip cells on one side of the sporangium. Notice the cells of the annulus, which extend around the sporangium from the lip cells. Spores should be visible within the sporangium.
In the drawings below label: pinna, vein, sorus, indusium sporangium, stalk, lip cells, annulus, spore.



Put a drop of glycerin at the edge of the coverslip. Watch for a change in the sporangium. If no change occurs, add additional glycerin, one drop at a time, until the sporangium opens.

1. Where did the cells separate as the sporangium opened?_____

_____

2. Describe the change in the cells of the annulus.

_____

_____

3. How did the glycerin cause this change?_____

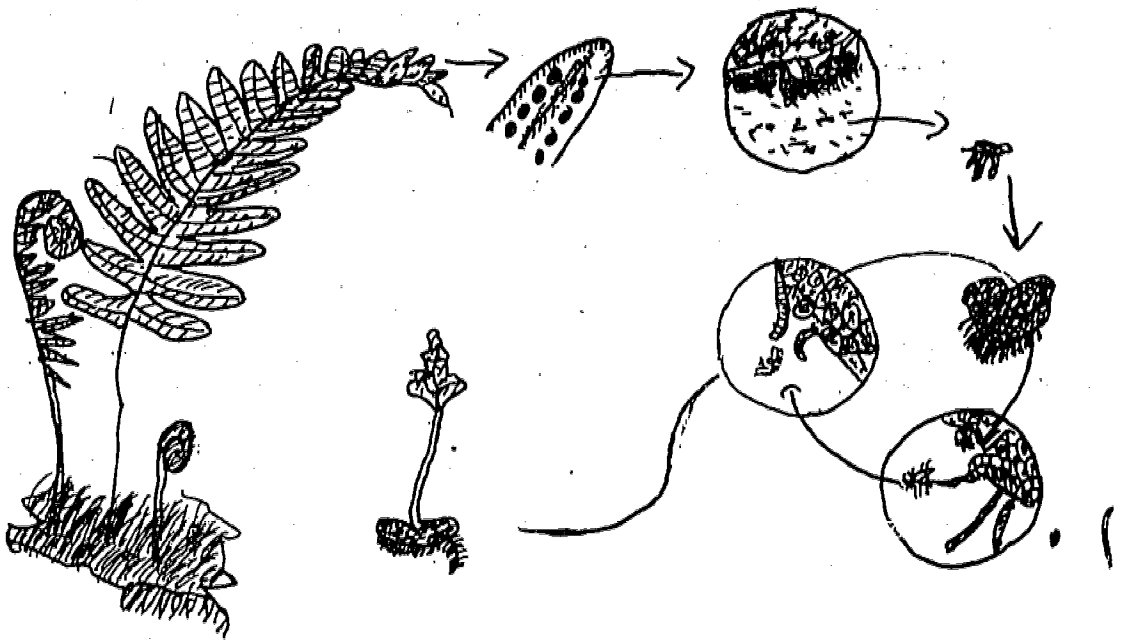
_____

4. What conditions in nature would cause the sporangia to burst open and discharge spores?_____

_____

B. Life Cycle of a Fern

The life cycle of a fern shows how this plant lies between the mosses and seed plants in evolutionary development. There is an alternation of generations in which the sporophyte is independent and conspicuous. The ferns continue the trend toward a smaller, dependent gametophyte. Below are shown the various stages of the fern life cycle. Label each stage and indicate whether it has the N or 2N chromosome number.



C. Identification of Ferns

Using your taxonomic key familiarize yourself with the characteristics used in their identification. These include: general form and structure, distribution of the sori, the sporangia, the indusia, and the form of the frond.

A number will be assigned to each specimen to be identified. Be sure to look at both sterile and fertile fronds. When you complete the identification fill in the chart below.

Specimen Number	Genus and Species	Common Name(s)

INTERPRETATION:

1. Which is the most conspicuous generation in the fern life cycle, the sporphyte or the gametophyte?

2. Discuss what is happening to the gametophyte as you move toward the higher plants?

3. Of what importance are structural characteristics for identification of organisms?

4. Why have ferns become an insignificant part of the flora?

5. Why are ferns unable to compete with the more highly developed flowering plants?

ENVIRONMENTAL INVESTIGATION: A General Study of Arthropods

Suggested Grade Level: Secondary

Suggested Study Area: Dickson School, Roller Woods, Bays Mountain

Equipment: Insect Collecting Nets, Collecting bottles, hand lens, identification keys for insects and arthropods

THEME: The insects are the largest group of animals. Biologically speaking they are the most successful.

Background Information:

Arthropods live almost everywhere. They can be found in salt water and fresh water habitats, soil, land and air habitats. Some parasitze plants and others animals. They range in size from tiny mites about 1/50 of an inch long to the size of giant Japanese crabs. Sometimes they are 12 feet across from leg tip t leg tip. Arthropods are the only invertbrates that have jointed legs and they are the only invertbrates that can fly. The arthropods are divided into five main classes: Insecta (insects); Arcahmida (spiders); Crustaces (crayfish and lobster); Chilopoda (centipedes); Diplopoda (millipedes).

Objectives:

To examine and analyze arthropods in their native haitats.

To develop an awareness of man's relationship with arthropods.

PROCEDURE:

A. Divide each class into five groups. Assign to each group a class of arthropods. Have each student in each group keep personal data sheets. Concerning all information obtained as to location, type of arthropod, size, abundance, type of habitat, etc.

B. Each group should separately locate an area where a particular class of arthropods may be found. For example, the groups collecting insects will visit a field and use collecting nets for obtaining specimens. Those looking for centipedes or millipedes will examine a dead log etc. Caution the students for safety and awareness of harmful snakes or poison spiders. Also be careful of poison ivy. Examine and observe your selected area very carefully.

C. Following your observation and collection of specimens, discuss the basic life processes of each class and complete chart 3 of this investigation.

Insect Data Sheet - Chart I

Common Name of Insect	Order	Type of Metamorphosis and stage of Development	Number of Abdomen Segments	Number of Wings	Number of Antenna	Drawing of 3 Body parts	Other Specialized Structures

Complete the following Chart with Identifying Characteristics - Chart II

	Crustaces	Centipedes	Millipedes	Arachnids
Number of Legs				
Number of Antenna				
Number of Wings				
Number of Eyes				
Type of Eye Structure				
Molting				
Number of Body Parts				
Type of Habitat				
Method of Breathing				
Economical Importance				
Location of Habitat				

Basic Life Processes - Chart III

	Crustaceans	Centipedes	Millipedes	Arachnids	Insects
Food-Getting					
Digestion					
Circulation (food & oxygen)					
Respiration					
Excretion					
Reproduction					
Types of Sensory Organs					

INTERPRETATION:

1. List the most numerous kind of insect found.

2. Other than insects, what was the most common arthropod found?

3. How are insects and other arthropods in competition with man?

4. What are some ways man has been able to curtail the growth of insect population?

ENVIRONMENTAL INVESTIGATION: Environmental Influences on Populations

Suggested Grade Level: Secondary

Suggested Study Areas: Dickson School Nature Park, Roller Woods, Bays Mountain

Equipment: Pencil, paper, magic marker or fingernail polish or paint, measuring tape or yard stick, string or cloth markers

THEME: Introduction

Biologists who study natural population of animals often need to know how many organisms make up these groups. Sometimes, however, for one reason or another the animals are difficult to observe, and an exact count cannot be made. In such a case it may be possible to estimate the size of the population by the capture - recapture method. This method involves capturing some of the population members, marking them, releasing them and after a period of time capturing a second sample.

Objectives:

To analyze population growth in a biotic community.

To observe and record physical factors that influence population size in a given environment.

PROCEDURE:

A. Divide the class into two or even four groups. Have each group decide on what type of organism they wish to do a population count. Some suggested animals might be a population of land snails, caterpillars, grasshoppers, salamanders, turtles, sow bugs, crayfish or toads.

B. Each group should select a large enough area where a good population of animals will be represented. This area should be marked off using string. The area should be identified, labield and a list of the various vegation growth recorded. Describe the topography of the land such as mountains, open field, ravine, marsh, etc. Perhaps someone in each group could draw a map of the selected area. The purpose of this would be to discuss all factors involved in the population study. Record your information on the attached data sheet.

C. Instruct each group to collect as many specimens as possible. Have them count and record the captured individuals (m), mark them with some permanent identification, and release them. Wait for one week so the marked ones have a chance to mix with the population. Then permit each group to collect specimens again. Count this second sample (T) and determine how many of these recaptured specimens are marked (P). Use the follwing formula to estimate the total population size.

$$N = \frac{M \times T}{P}$$

INTERPRETATION:

1. To what sources of error is the capture-recapture method subject?

2. By what other methods might the number of animals in a population be estimated?

3. To what extent has man's activities influenced the population studied?

4. From your investigation, what physical factors did you find that affected a given population?

Data Sheet

	Date	Name of Animal	Place of Capture	Number Captured 1st	Number Captured 2nd	Description of Topography
Group I						
Group II						
Group III						
Group IV						

COMMUNITY RELATIONSHIPS

ENVIRONMENTAL INVESTIGATION: Investigating the Environment With Your Senses

Suggested Grade Level: Lower Elementary

Suggested Study Area: School Campus

Equipment: Folding table, hand lenses, plastic containers

THEME: There are many variations in the natural world.

Objectives:

Use four of the five senses to describe the natural environment in a small designated area.

Communicate orally through discussion the varieties of living and nonliving materials observed.

Categorize materials into living and nonliving groups.

PROCEDURE:

Class can work in groups of two. Provide each team with several plastic bags and several plastic containers. Let each team select a spot. There is one rule: Make a collection of one of everything you can reach from where you are seated. Do no crawl. Do not stand up. Encourage the children by challenging them to see how far they can reach without breaking the rule. Allow them to stretch flat on their stomach.

All nonliving items should be put in separate plastic bags, live materials in plastic containers. Encourage them to search through the leaf litter to the soil.

When they have completed their collection they should meet at a central meeting place. Display the live materials on the folding table. Each group should free their live collections.

Use hand lenses and microscopes for closer observations. Sketches may be made in the classroom from memory. Display the nonliving material according to categories suggested by the children. Some possible categories are: green leaves, dried leaves, seeds, acorns (nuts), dirt, twigs, bark, stone, dead insects, "stuff" (miscellaneous - nonrecognizable).

INTERPRETATION:

1. Ask for descriptive words for objects leading up to a discussion of the five basic senses. Take one object at a time and continue until you have at least 10 descriptive words under each group, such as:

Feel	Look	Smell	Hear
rough	tiny	damp	rattles
smooth	round	like straw	like stones
bumpy	egg shape	like dirt	empty
fuzzy	flat		

2. What was the most common material collected?

3. What was the least common material collected?

4. Why were some materials found in a certain area and not in others?

5. Which of the five senses should be used with caution in investigation?

6. Arrange the items found in like or unlike sets.

ENVIRONMENTAL INVESTIGATION: Diversity and Variation in Pond Life

Suggested Grade Level: Lower Elementary

Suggested Study Area: Bays Mountain Aquatic Pond

Equipment: Plastic collecting jars, large plastic bucket, rubber gloves, nets, children should wear boots or old sneakers, hand lens

THEME: All living things exhibit varieties and similarities

Objective:

1. To identify and examine animals living in a pond.

2. To recognize the diversity of living organisms.

PROCEDURE:

Each child should have a plastic collecting container. Encourage children to collect from different parts of the pond. If it is warm or if someone has very high boots, try to get some water and mud from a deeper part of the pond than the edge.

Collect a lot of water and mud from the pond. Scoop up lots of green scum.

The teacher should keep silent about the observations each child makes about his findings. If a teacher tells the class too much about their animals, the children will parrot it back instead of making discoveries of his own. Many children need to spend a lot of time observing one animal carefully. A "worm" may turn out to have legs after a student has observed it closely.

Use hand lens to observe animals found.

Attempts may be made to classify the animals according to discoveries made by the children.

Be sure to include insects in your study.

INTERPRETATION:

1. How many of the animals you found had:

   Eyes_____
   Legs_____
   Antennae_____
   Tail_____

2. Just as there is a variety of animals in the pond, how is there a variety of animals in our community?

	Drawing of Animal	Eyes	Legs	Antennae	Tail	How does it feel	Other things you see
1.							
2.							
3.							
4.							
5.							
6.							
7.							

ENVIRONMENTAL INVESTIGATION: Interrelationship of Man and Insects

Suggested Grade Level: Lower Elementary

Suggested Study Areas: School Campus, open fields

Equipment: Insect nets, killing jars, insect pins, hand lens, pinning boards, Golden Nature Guide, microscope

THEME: Interrelationships and interdependences exist between man and the many varieties of living organisms.

Objectives:

To examine and analyze the many varieties of insects.

To develop skills in collecting, preserving and identifying insects.

To generalize from data collected as to why insects are adjusted to different habitats.

To recognize the ways in which man and insects are interrelated.

PROCEDURE:

A collection of flying insects can be made by using an insect sweep net. Make 48 low sweeps over the vegetation with the net, one sweep with every step you take in a straight line. Brush the vegetation gently as you make your sweep with the net. This sampling may be considered roughly equal to a covering of 1 square mile.

Using an insect killing jar, prepare the insect to be preserved. (Do this only under direction from your teacher.) After a few minutes the insects can be sorted and all of them placed into a jar of preservative. Label each jar with type of collection, date, area covered, and team number if you divided the class into teams. After the insects have been killed, they can be sorted and put into labeled jars of 70% formalin for perservative.

Sort the insects into groups of obviously different species. Count the number of each species. Total the number of each species found in all samples in descending order of abundance (from the most abundant). Record your information on the attached data sheet.

INTERPRETATION:

1. In which habitat area did you find the most insects? the least? Give some reason for this.

2. How do insects affect the human environment?

3. How has man through the use of pesticides affected insects?

DATA SHEET

Name of Insect Family Name or Common Name	Location of Net Sweep (Near Trees, Shrubs, etc.)	Number Found	Helpful or Harmful Insect

ENVIRONMENTAL INVESTIGATION: Diversity In A Biotic Community

Suggested Grade Level: Upper Elementary

Suggested Study Area: Bays Mountain Aquatic Pond, Mad Branch

Equipment: Compound miscroscopes, hand lens, dishes of pond water, cotton

THEME: All living things exhibit varieties and similarities.

Objectives:

To examine and identify some common microorganisms found in a typical pond.

To develop an awareness of the variations and similarities that exist in a given environment.

Through use of the microscope, develop observational skills.

PROCEDURE:

Before making microscopic examinations, the students should have the opportunity of making examinations of the pond water with hand lens.

Using a single drop of pond water on a microscope slide, investigate kinds of microorganisms found.

To decrease the motility of the organisms, threads plucked from cotton and applied to the slide are effective in trapping some of the larger micro-organisms.

The teacher should spend some time making his own observations so he may anticipate problems the children will encounter with the microscope. Often students have difficulty distinguishing between air bubbles, scratches on a slide or cover slip, and living organisms. Remember that few things of nature are perfectly round (air bubbles) or perfectly straight (scratches).

The children will expect the teacher to be able to identify everything they see. Very few biologists know the names or can recognize all organisms in a sample of pond water. The name of the organisms does not change the organism. The children may assign any name they wish to what they see. The only rule about naming them is to be consistent.

Using data sheet, have students make large drawings of forms seen. Students should understand that records are kept simply because one cannot recall everything. It would be helpful to begin the development of a "gallery" of organisms seen.

DATA SHEET

Worksheet

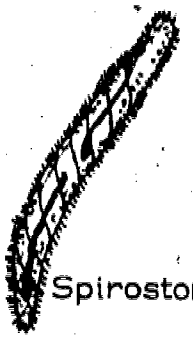
MICROSCOPIC FORMS SEEN

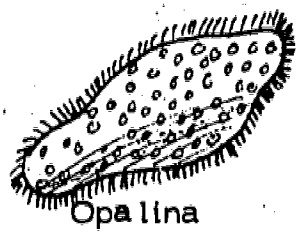
The drawings may be posted on the bulletin board later and used as references during class discussions.

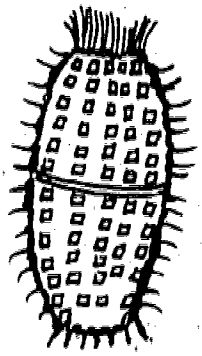
INTERPRETATION

1. What microorganisms were most abundant?_____
2. What microorganisms were least abundant?_____
3. What similarities did you notice in the organisms?_____
4. What differences did you notice in the organisms?_____
5. What varieties and similarities exist in your own environment?_____

_____

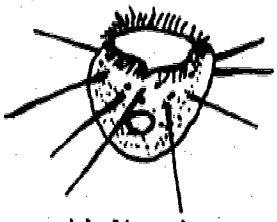

Spirostomum

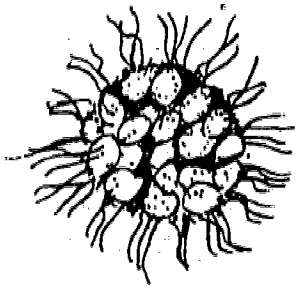

Opalina

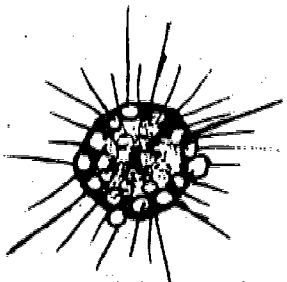

Coleps

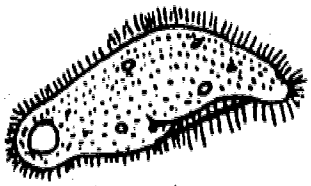

Stentor


Chilomonas

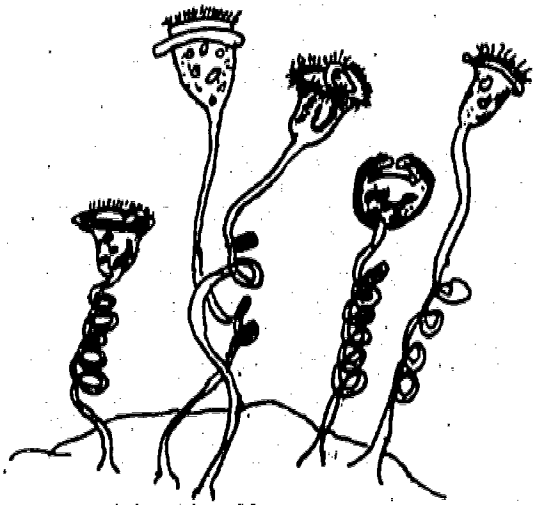

Halteria


Synura

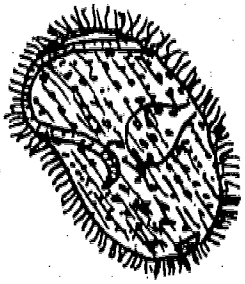

Actinophrys


Blepharisma


Colpidium

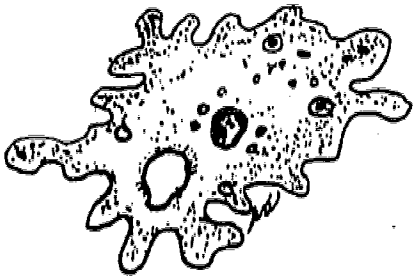

Vorticella


Peranema


Nyctotherus


Euglena


Paramecium


Amoeba

ENVIRONMENTAL INVESTIGATION: Role Of Macroscopic Organism in A Community

Suggested Grade Level: Upper Elementary

Suggested Study Area: School Campus

Equipment: Collecting jars, markers to mark off study areas (round hoops desirable), insect sweep nets, hand lens

THEME: Animals and their function in community.

Objective:

Compare the number of macroscopic organisms found in two communities, analyze and classify macroscopic organisms.

Compare and relate the role of macroscopic soil organisms in decomposition to man's need for recycling.

PROCEDURE:

Capture and count the macroscopic animals in soil and leaf litter. Divide the class into teams and mark off standard areas for each group study. Mark off the areas at random or in specific areas in the habitat you wish to study. The students from each team then capture and preserve all animals that they can see within the enclosure. Two samples can be taken within the marked enclosure: (1) the animals found in the organic materials (litter) on the surface of the soil, (2) the animals captured in the soil (say from 0-10 cm.) These samples should be placed in bottles and plainly marked as to the kind of sample, the date, the location and the team.

Make careful observations of each plot for spider burrows, etc.

Hand lens may be used in studying animals. Sort the animals of each sample into groups of obviously different species of animals. List each species by name or number. Count the number of each species and record it opposite the name of the species in a column bearing the sample number. Total the number of each found in all samples.

DATA SHEET

Species of Animals (Name or Picture)	Number Found	Where Found (Surface Litter or Subsoil)

Total class data: Record the number of each species found in all samples.

INTERPRETATION

1. In which soil sample were the most animals found?
2. How did the animals in the subsoil differ from those in the leaf litter?
3. How would you compare the role of microscopic soil organisms in decomposition to man's need for recycling?

ENVIRONMENTAL INVESTIGATION: Succession In A Biotic Community

Suggested Grade Level: Secondary

Suggested Study Area: Dickson Nature Park, Roller Woods

Equipment: Balance and weights, some empty fruit jars, pH paper, test tubes, distilled water, Berlese apparatus, ringstand, beakers, alcohol, cheesecloth, plastic bags, rubber tubing, ringstand clamp, glass plate, distilled water, hand lens, potato-sugar-agar mixture, rose bengal stain, spade or shovel .

THEME: Communities are constantly changing systems living in and forming parts of environments that are also changing.

Objectives:

To investigate ecological succession through continued field study and analysis.

To explore the detailed environment of a restricted biotic community by careful observations and measurement, recording data and comparing results.

PROCEDURE:

A. A Quadrat.

Divide the class into small groups. Permit each group to carefully select an area for the investigations. Instruct each group to explore an area about 3 or 4 foot square. Using a yard stick, string and stakes, mark off the suggested area. Begin the investigation with a detailed observation of the kinds and number of living organisms located on the surface. Record them in your notebook. Make a sampling of the different types of rocks on the surface. If you can identify them, record in your notebook as one of the three major kinds of rocks. Strip your plot of all its vegation. Use a spade or shovel to turn over a few lumps of soil. Do not disturb any tree roots or rocks that you might uncover. Record the condition of the soil. Is it sandy, rocky, or mostly clay or rich topsoil? Is your plot near water? Are animals likely to visit the area? Is the plot sheltered by trees or is it in an open field? Each group should plan to examine their plot at least once a week or as often as possible. Perhaps one student from each group could observe any changes and report them to the class. Each group should design tables and graphs to record the changes made by weekly observations. Such a table is listed on your data sheet.

B. Soil Analysis.

1. Texture.

Texture refers to the size of the soil particles. Is the soil in your plot gravel type, sand type, or clay type? Soil with particles smaller than 2 mm can be called sand, and soil larger than 2 mm can be termed gravel.

Soil with fine, powder-like particles that stick together in water is termed clay.

2. Organic-Matter Content.

Organic matter is material that was formerly living material. It includes dead leaves and roots. Soil is composed of organic and inorganic material.
To test the organic material content of the soil in your plot, dry a small amount of the soil in a warm oven for 24 hours. Do not bake the soil. Just dry it. Then weigh the dried soil. Record this figure. Then place the dried soil in the broiler of the stove. Leave it for about two hours. This will burn away all the organic matter in the sample. By using the following formula, calculate the percentage of organic matter:

$$\text{Per cent organic matter} = \frac{\text{loss of weight}}{\text{dry weight}} \times 100$$

3. Moisture Content.

How much water does the soil in your plot contain? Weigh a sample of the soil. Dry this sample overnight in a warm oven. Your school will probably have an incubator. After the soil is dry, weigh it again. Use the following formula to determine the percentate of water in the soil.

$$\text{Per Cent Moisture} = \frac{\text{loss of weight}}{\text{dry weight}} \times 100$$

4. pH Value of the Soil.

Is the soil in your plot acid or alkaline? You can determine this by measuring the pH value of the soil. The pH value is the degree of acidity or basicity of a substance. Obtain some pH paper. Mix an equal amount of soil and water. Dip a strip of the pH paper in the mixture. Then compare the color of the strip with the color chart that accompanies the pH paper. Be sure to mix the soil with distilled water. The pH of distilled water is 7. Record your sample as alkaline, acid or neutral.

C. Inventory.

The following activity is accompanied with a data sheet. Observations and recording data should be listed at the beginning of the study and at the end. The purpose is to obtain an estimate regarding the changes in population growth.

1. Vegetation:

Divide the vegetation in your plot into 4 main groups: trees, shrubs, herbs, and grasses, mosses. Record the number count on the attached data sheet

2. Height.

At least a mimimum of five readings should be taken on each type of vegetation. This will give an average of each type plant.

3. Coverage.

Calculate the percentate of coverage of each type of vegetation. This information is obtained from the data sheet. Use the following formula for determining this percentage:

$$\text{Approximate coverage of each type of vegetation} = \frac{\text{No. of each type of plant}}{\text{total No. of plants counted}} \times 100\%$$

D. Leaf Characteristics

1. Leaf Type.

Classify the leaves belonging to anyone species of plant into one of these groups. Simple leaf, compound leaf, needle type, grass type, small-medium type, broad large type.

2. Leaf Texture.

Four categories of leaf texture may be used in the study of leaf characteristics. Filmy (ferns); papery (majority of plants); hard and tough (chaparral); and succulent (cactus). Record this information on your data sheet.

3. Leaf Shape.

On your data sheet and from the information obtained from your leaf type study, make a sketch of the leaves you collect. These leaves may also be pressed or mounted and used later in your classroom discussion.

E. Soil Orgainsms

1. Arthropods .

Arthropods include insects, spiders, centipedes and crustaceans. They usually live on or near the surface of the soil among the grasses, twigs, and fallen twigs. The material that covers the top of the soil is known as surface litter.

From your plot, collect a small sample of this surface litter and place it in a small sieve. Using the Berlese apparatus from your Mobile laboratory, dry the soil from the top down. Observe what happens to the organisms in the sample.

2. Nematodes.

Nematodes are threadlike worms. They are very abundant in moist soils. Carefully select a small sample of soil from your plot. Wrap your sample in cheesecloth and tie the cloth into a plastic bag. Place the bag in a funnel. Close the stem of the funnel with a piece of rubber tubing and a clamp. Use a ringstand to suspend the apparatus over an empty container. Fill the funnel with water until the cheescloth bag is about three-quarters covered. Add water to make up for evaporation. The nematodes will crawl into the water. They will crawl through the cheesecloth down into the funnel. After two days draw off the bottom inch of water in the tube. Pinch the tubing by the funnel stem, and then open the clamp. Examine the water you collect under a microscope? Make sketches of your observations.

3. Protozoans.

Age some water for two days. Boil a few grains of rice in a small flask of this water. Allow the water to cool to room temperature, then add 1/4 teaspoonful of soil from your plot. Stopper the flask with cotton and put it in a dimly lit place. Examine the water with a microscope from day to day. Make sketches of your observations and compare or identify with your textbook.

4. Algae.

Add one-half teaspoonful of liquid fertilizer to a quart of distilled water. Then add 1/2 teaspoonful of soil from your plot. Place the container in direct sunlight for a few days. Examine any samples of algae that you observe growing. Using a micrsocope, try to identify the types of algae growing. Compare these with your drawings from the textbook.

INTERPRETATION:

1. Based on your investigations, what components of this community are in continuous change?

2. What environmental factors contribute to these changes?

3. Is there a relationship between the size of an organism and their abundance in a community? If so, how?

4. Were there any indications of man's influence on the succession in this community?

Group No.__________

Soil Analysis Chart - Activity B

Soil Texture				Percentage of Organic Matter	Percentage of Moisture Content	pH Value of Soil
Clay	Sand	Gravel				

Data Sheet - Activity C

Type of Vegetation	Number of Examples 1st	2nd	Height 5 Readings					Average Height	Difference in Number	Difference in Height
Trees										
Shrubs										
Herbs & Grasses										
Mosses										
Other Simple Plants										

ENVIRONMENTAL INVESTIGATION: Study Of A Forest Community

Suggested Grade Level: Secondary

Suggested Study Area: Bays Mountain, Roller Woods

Equipment: Ball of strong cord, tree key, clip board

THEME: This type of field exercise is a useful way of introducing students to basic ecological concepts by study of a group of plants with which they may already be somewhat familiar. The investigation will be simplified by studying only 2 groups of woody plants (trees and shrubs).

Background Information:

Limiting the study to woody plants has the advantage of reducing the kinds of plants to a workable number. The line transect is suggested as an alternative for the more widely used quadrat, as it is easier to use and less exasperating to the impatient student. It is not necessary that all transects be joined end to end, but doing so restricts the space which the teacher needs to supervise. It is desirable, if possible, to have some transects cross areas of heavy shade and some areas of light shade or exposure to sun. The cores marking the transects should be removed after completion of the counts.

It is highly important that you scout the study area thoroughly before taking the class to it so that full advantage may be taken of preliminary estimates of best locations for transects. If possible, select an area which has at least 5 kinds of trees and 5 kinds of shrubs. The undergrowth should be fairly open, so that students will not have too much difficulty in setting their transect lines.

Objectives:

To identify trees commonly used in logging for the lumber industry.

To collect leaf samples for classification.

To construct a transect.

To identify some of the variables affecting man's dependence on his environment for economic support.

A general area within which your observations are to be made has been selected. Using 10 large trees as landmarks, draw up a plan for making sample counts of the different kinds of trees and shrubs. A simple but effective way to do this is shown in figure 1.

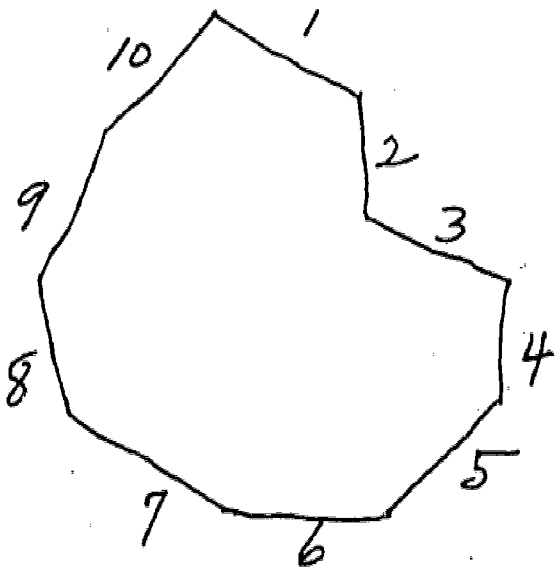


Fig. 1. Example of line transect layout for study of plant community.

Draw a strong cord as tightly as possible between successive pairs of the land mark trees. The cord should be 3 or 4 inches above the ground or higher if necessary to pass over most of the low lying non-woody plants. It may sometimes be necessary to detour the string around a shrub or as nearly as possible in a straight line (called a transect) between the larger trees. All pairs of trees should be about the same distance apart. When the ten trees have been connected with cords, you will have an irregular but completely enclosed ten-sided area.

Divide the class into small groups and appoint a counter, a collector, and a recorder for each group. To avoid duplication, the counter should do all tallying of individual plants. The collector will be responsible for taking along specimens of each kind of woody plant found, and for assigning a temporary identifying symbol for each kind. The recorder will tabulate the information given him by the counter as to numbers of each kind. Details of these procedures are given below.

Beginning at the tree designated as the starting point for your group, follow the transect to the next tree, counting woody plants of all sizes along the way. Transects should be approximately 10 yards in length. A transect belt can be created by counting all of the woody plants within 1 foot of either side of the transect line.

Each time the counter finds a new kind of woody plant, he should point it out to the collector. The collector then assigns to the new plant a letter symbol, beginning with A and continuing with B, C, etc., for each new type of plant added. The counter, collector, and recorder should use this symbol as a temporary name for the plant until it is possible to learn its correct name. Even if you believe that you already know the name of the plant, use the letter symbol until you have time to positively identify the plant. The collector should take along a specimen of each plant. The collector should take along a specimen of each kind of woody plant found (except poison ivy or posion oak); tagging it with its symbol letter. Specimens should not be collected from plants touching the cord or under it, but from other plants of the same kind in the area. The entire plant should not be collected - just a twig bearing a few leaves.

After each transect has been counted the entire class will meet as a unit to summarize and tabulate results. This can best be done while still in the woods, but if time does not permit this, the specimen can be taken back to the classroom. As you make counts of the different kinds of woody plants, you found that knowing the name of a plant was not necessary for you to distinguish it from other plants. Instead of a name, you were able to give a temporary symbol. But names cannot long be avoided. You would find it inconvenient for very long to call a classmate A instead of his real name. Likewise, if you tell other persons about a plant, ask questions about it, or look it up in a reference book, a name for it is not only a convenience but a necessity.

As you begin to organize the information about the numbers and kinds of woody plants found along the transects on your field trip, the need for uniform names for these plants will be obvious. It has probably already occured to you that the kind of plant that you called A is not likely to be the same plant which some other groups of your class called A. Using the tree keys, identify all of the plants which your group collected on the trip. Then combine this information with similar information from other groups in Table 1.

INTERPRETATION:

1. Did all groups find the same kinds of plants?

2. Was the same kind of plant as numerous in one transect as in another?

3. Which species of plant was most numerous?

4. Was the distribution of plants haphazard, or did the plants seem to be distributed in patterns which were associated with variations in light, temperature, water, etc.?

5. Did the same kind of plant always look about the same or did it look different if found under different conditions of light, temperature, etc.?

6. What was the most abundant kind of tree found within the transect which is used by the lumber industry?

Table 1

Summary of Transect Studies of Woody Plants

Kinds of Plants	Transcent Line Number										Totals
	1	2	3	4	5	6	7	8	9	10	
Trees											
Shrubs											
Totals											

In the chart below list the number of each kind of tree found within the transect.

Trees Commonly Used
By The Southern Lumber Industry

Name of Tree	Number of Species
Oak	
Maple	
Ash	
Elm	
Sycamore	
Black Gum	
Pulpwood Trees	
Aspen	
Hemlock	
Spruce	
Pine	

ENVIRONMENTAL INVESTIGATION: Survey Of A Plant Community - An Introduction To Quadrat - Sampling Techniques

Suggested Grade Level: Secondary

Suggested Study Area: Bays Mountain, Roller Woods

Equipment: Strong twine over 100 m. long, four stakes, hammer, compass, milimeter ruler, notebook, paper, pencil, meter sticks, Biltmore sticks

THEME: In order to gain a better understanding of community interrelationships, the ecologists uses various quantitative sampling methods.

Objectives:

To measure the coverage or area of occupancy, and abundance of the more common plants and calculate their densities and frequencies.

To analyze the functional relations of the more common organisms in the community.

To interpret quantitative information about the structure and composition of plant communities.

PROCEDURE:

A. Selecting and Plotting the Site.
Select the sample site and set up the boundaries of the square sample area (quadrat) as follows: Measure a 100 m length of strong twine. Make 0.5 m divisions of the 100 m length by tying colored twine at these lengths. Drive a stake at the edge of the site. Using a compass, sight the opposite corner. Drive the second stake exactly 70.7 m from the first stake. Tie one end of the 100 m length of twine to each stake. Then pick up the center mark on the twine and walk at right angles to an imaginary line between the first two stakes. Drive the third stake at the point where the line is tight. Reverse the process to place the fourth stake. This will give a 50 square meter site for examination. A smaller area may be used if the area is heavily populated with plants. Plot the site on graph paper and divide it into subplots.

B. Identification and Measurement of Individual Plants.
Trees and Saplings: Trees and saplings are woody plants over two meters in height. If the plot is sparsely wooded, measure the diameter of each tree found. If the site is heavily wooded, use the meter stick method of sampling. In this method, one student holds two meter sticks, one in each hand at right angles to the body at chest height. He then walks a 20 meter transection of the wooded area. All trees, large or small, that are touched by any part of either meter stick are used in the survey. Use the Biltmore stick to measure the diameter of the tree and obtain the basal area (cross-sectional area of the trunk) from Table 1. Record the individual basal area value in Table II, where they will indicate both the number and size of the individuals of each species encountered.

Shrubs and Herbs.

Shrubs may be defined as low woody plants. Measuring between 0.5 m and 2 m in height. Herbs are non-woody plants which die down to the ground at winter. These include weeds and other small flowering plants. Sampling should be done from each subplot of the quadrat site. Choose plots 1 m square in each subplot and measure the diameter of the crown foliage of each plant. Obtain the areal coverage of the crown from Table I. Individual coverage value is then recorded in Table II, when they will serve to indicate both the number and size of the individuals of each species encountered.

Table I
Conversion of Diameter Measurements to Circular Area Values

Diameter	Area	Diameter	Area	Diameter	Area
0.5	0.20	20.5	330.06	40.5	1288.25
1.0	0.78	21.0	346.36	41.0	1320.25
1.5	1.77	21.5	363.05	41.5	1352.65
2.0	3.14	22.0	380.13	42.0	1385.44
2.5	4.91	22.5	397.61	42.5	1418.62
3.0	7.07	23.0	415.48	43.0	1452.20
3.5	9.62	23.5	433.74	43.5	1486.17
4.0	12.57	24.0	452.39	44.0	1520.53
4.5	15.90	24.5	471.43	44.5	1555.28
5.0	19.63	25.0	490.87	45.0	1590.43
5.5	23.75	25.5	510.70	45.5	1625.97
6.0	28.77	26.0	530.93	46.0	1661.90
6.5	33.18	26.5	551.54	46.5	1698.22
7.0	38.48	27.0	572.55	47.0	1734.94
7.5	44.18	27.5	593.96	47.5	1772.05
8.0	50.27	28.0	615.75	48.0	1809.56
8.5	56.75	28.5	637.94	48.5	1847.45
9.0	63.62	29.0	660.52	49.0	1885.74
9.5	70.88	29.5	683.49	49.5	1924.42
10.0	78.54	30.0	706.86	50.0	1963.49
10.5	86.59	30.5	730.62	50.5	2002.96
11.0	95.03	31.0	754.77	51.0	2042.82
11.5	103.87	31.5	779.31	51.5	2083.07
12.0	113.10	32.0	804.25	52.0	2123.71
12.5	122.70	32.5	829.58	52.5	2164.75
13.0	132.73	33.0	855.30	53.0	2206.18
13.5	143.14	33.5	881.41	53.5	2248.00
14.0	153.94	34.0	907.92	54.0	2290.22
14.5	165.13	34.5	934.82	54.5	2332.83
15.0	176.71	35.0	962.11	55.0	2375.83
15.5	188.69	35.5	989.80	55.5	2414.22
16.0	201.06	36.0	1017.88	56.0	2463.01
16.5	213.82	36.5	1046.34	56.5	2507.18
17.0	226.98	37.0	1075.21	57.0	2551.76
17.5	240.53	37.5	1104.46	57.5	2596.72
18.0	254.47	38.0	1134.11	58.0	2642.08
18.5	268.80	38.5	1164.16	58.5	2687.83
19.0	283.53	39.0	1194.59	59.0	2733.97
19.5	298.65	39.5	1225.42	59.5	2780.50
20.0	314.16	40.0	1256.64	60.0	2827.43

Table II

Data Sheet for Crown Cover or Basal Area Measurements of Individuals of Various Species Encountered in Quadrat Sampling

Species	Basal or Crown Areal Coverage										Total
	Subplot # 1	Subplot # 2	Subplot # 3	Subplot # 4	Subplot # 5	Subplot # 6	Subplot # 7	Subplot # 8	Subplot # 9	Subplot # 10	

C. Determining the Density, Dominance, and Frequency Values for each Species. Density refers to the number of individuals in relation to the space in which they occur. It also refers to the closeness of individuals to one another. Dominance is the condition in communities or in vegetation strata in which one or more species, by means of their number, coverage, or size, have considerable influence or control upon the conditions of existence of associated species. Frequency refers to the degree of uniformity with which individuals of a species are distributed in an area. For a particular species, these values may be expressed either in an absolute form or in a relative form, which shows the percentage that the species value is of the total for all species. Relative values for density, dominance and frequency may be combined into a single importance value, which reflects these three somewhat different measures of the importance of the species in the community. These various vegetational measurements are determined according to the following formulas:

$$\text{Density} = \frac{\text{Number of individuals}}{\text{area sampled}}$$

$$\text{Relative Density} = \frac{\text{density for a species}}{\text{total density for all species}} \times 100$$

$$\text{Dominance} = \frac{\text{Total of basal area or areal coverage values}}{\text{area sampled}}$$

$$\text{Frequency} = \frac{\text{Number of plots in which species occurs}}{\text{total number of plots sampled}}$$

$$\text{Relative Frequency} = \frac{\text{Frequency value for a species}}{\text{total of frequency values for all species}} \times 100$$

Important Value = Relative density + relative dominance + relative frequency

Record summarized vegetational measurements in Table III

Table III

Summary of Vegetation Analysis by the Quadrat Technique

Species	Density ( )	Relative Density	Dominance	Relative Dominance	Frequency	Relative Frequency	Importance Value

INTERPRETATION:

When all data sheets are complete do the following:

1. List which species contain the largest trees and note whether certain species appear to be reproducing their kind.

2. Make a list of plants from the most abundant to the least abundant species.

3. Make a list of plants from the most dense to the least dense species.

Answer the following questions:

1. What is the value of converting absolute values to relative values?

2. What is the reason for combining the three relative values into a single importance value?

ENVIRONMENTAL INVESTIGATION: Succession In a Dynamic Community

Suggested Grade Level: Secondary

Suggested Study Areas: Dickson School Nature Study Area, Roller Woods

Equipment: Collecting jars, notebooks, identification keys

THEME: Communities are dynamic systems living in and forming parts of environments that are also dynamic.

Background Information:

The procession of events continually occuring in a community of interdependent and interacting organisms is termed succession.
The principle of succession may be demonstrated in microhabitats within a community such as in rotten logs. In each case the microhabitat undergoes chemical and physical changes and eventually becomes a part of the soil. Most of the changes are brought about by biotic forces. Bacteria, fungi, invertebrates and vertebrates aid in the changes which take place.
The rotting log succession has its beginning while the dead tree is still standing. Insects and other invertebrates may inhabit the bark and outer wood. Birds and mammals may use parts for nesting.
The tree finally falls to the ground after being weakened by the effects of boring insects and the rotting effects of bacteria and fungi. The bark falls away, and new inhabitants move in. More boring and fungus groups will inhabit the log. The inside becomes soggy. The outer portion remains firm. Shrews, mice, lizards and salamanders are often found in hollowed out sections.
Finally the outer shell disintegrates, and as part of the forest floor, plays host to still different organisms. Many small snakes and worms find this habitat suitable to their needs. Finally the log is completely decayed.

Objectives:

To develop an awareness of the interdependence of living things.

To investigate some of the changes that are occuring continually in nature.

To analyze succession in a terrestrial community.

To compare and contrast natural recycling with man's efforts at recycling.

PROCEDURE:

A. Make observations of the rotten log succession by finding trees in various stages of decay as represented.

1. Stage I. Standing Dead Tree.

a. Is the bark on the tree?_____

b. If so, is it easily removed?_____

c. What invertebrates do you find under the bark?_____
In the wood?_____

d. Are there any squirrels or birds nesting in the tree?_____

Record all species of animals found on the data sheet for stage I.

2. Stage II. Newly Fallen Tree

a. Is the bark on the tree?_____

b. Is the wood soft, wet or dry?_____

List the invertebrates found on the data sheet for stage II.

3. Stage III. Log Rotting inside, hard outside. Lift off the outer shell and examine the contents. Break apart the shell and note all invertebrates. Rake through the rotting part of the log, being especially watchful for lizards, snakes, and salamanders as well as invertebrates. Record all species and their number on the date sheet for stage III.

4. Stage IV. Completely Rotten Log.

Rake through the rotten wood noting all species observed and their quantities on the data sheet for stage IV.

Rotten Log Data Sheet

Location _____ Date _____

Soil Type _____ Vegetational Type _____

Stage I		Stage II	
Condition of Log:		Condition of Log:	
No.	Species	No.	Species

Rotten Log Data Sheet
(Page 2)

Stage III		Stage IV	
Condition of Log:		Condition of Log:	
No.	Species	No.	Species

INTERPRETATION :

1. In what stage do you find the most organisms?

2. What difference do you find most striking in the first and last stage?

3. Discuss the interdependence of the various organisms found at different stages.

4. Based on what you have learned about natural cycles, how can man apply these principles to his own environment?

5. Diagram the cycle of transfer of materials and energy in the rotten log community.

IN-SERVICE ACTIVITIES

ENVIRONMENTAL INVESTIGATION: Investigating A Forest Environment: An In-Service Environmental Investigation

Suggested Grade Level: Elementary and Secondary

Suggested Study Area: Bays Mountain, Dickson Nature Park, Roller Woods

Equipment: Tree cross section, increment borer, hand lens, sketching paper, lab sheets, sketching material

THEME: With increased urbanization, forests become increasingly important ecologically, commercially, and recreationally.

Objectives:

As a result of these activities, you should be able to:
List at least three observations about the cross sections provided, and infer possible reasons for each observation.

Describe ways to set up an investigation to find out more about the above observations and inferences.

Construct an investigation to find out reasons for growth rate differences in a given stand of trees.

Describe activities appropriate to other environments for interpreting the landscape.

Identify and list at least three evidences of change in the environment, and infer the cause-and-effect relationships of these changes.

Construct a diagram of a cycle in a rotten stump.

Describe how you feel about one change in this environment.

Communicate feelings of awareness by constructing a sketch of a given object in the environment.

PROCEDURE:

Introduction:

In the alloted time we are going to make some inferences of why we think some things are the way they are based on observations; test out those inferences by experimentation, collect and interpret past events in this experiment, and explore ways that we can improve the efficiency of energy cycles. The following activities may help you look for observable changes, relationships, patterns and trends, in order to interpret past events, understand present relationships and indicate future trends in the forest environment.

A. Observing and Inferring with Cross Sections.
Using the cross sections provided complete TASK 1 and TASK 2:

TASK 1: (5 - 10 minutes) Work individually or in groups of 2 or 3

Write down some of the things you notice about the cross section

Questions and Discussion

1. Compare your observations with those of the other groups. What similiarities did you observe?_____

_____

What differences did you observe?_____

_____

2. What are some of the things that could account for the observations you made?_____

_____

TASK 2: (15 minutes) Work in groups of 2 or 3

Select 3 observations about the cross sections from the group list. List possible reasons for these observations. List ways you could set up an investigation to find out more about your observations and inferences.

Observation (What you noticed)	Inferences (Possible Reasons for this)	Investigations (How we could find out)
1.		
2.		
3.		

Questions and Discussion:

1. Which of these investigations could be carried out in this environment?

_____

2. What could tree rings tell us about past and present events in this forest environment?_____

_____

B. Collecting and Interpreting Data About Tree Growth Rate and Competition. Using the tree core supplied or following instructions for the use of an increment borer, acquire a core from a designated tree or trees and complete TASK 3 and TASK 4.

TASK 3: (15 - 20 minutes) Work in groups of 4 or 5
Observe the core and record the following information.

Tree #	Dark Rings from Center to Bark (Approx. age)	Dark Rings in Last Inch	Remarks about the Pattern of the Rings

TASK 4: (10 - 15 minutes) Work in groups of 4 or 5

Record the information about the core studied by each group in the following chart:

Tree #	Dark Rings from Center to Bark (Approx. age)	Diameter of the Trunk	# Dark Rings in Last inch	Remarks about Ring Pattern
1.				
2.				
3.				
4.				
5.				

Questions and Discussions:

1. What similarities do you notice in the data about the trees?

2. What differences do you notice in data about the tree?

TASK 5: (20 - 30 minutes) Work in groups of 4 or 5

Set up an investigation to find out reasons for some of the differences in the data:

1. Select 2 or 3 trees from the list that show differences in growth rates.
2. Which trees did you select? (Indicate by number)

3. Why did you select these trees?

Go to the site of the trees you selected and do the following:

Collecting and Recording Data:
Record your observations.

Interpreting Data:
Record possible interpretations of the above data.

Summarizing Your Investigation:
Write your group's summary below, including:
What you were trying to find out?
What data you collected about it?
What interpretations you made?
What other data would you collect about your investigation?

Questions and Discussion:

1. What problems did you encounter in this task?

2. What does the information tell us about the past events of this envrionment?

3. How would you summarize the major factors affecting the growth of this forest?

C. Interpreting Past Events

Based on your observations, complete TASK 6 and TASK 7.

TASK 6: (30 - 40 minutes) Work in groups of 4 or 5

Look for evidence of change (natural and man-made) in the environment. Record and fill out other columns

Evidence of Environmental Changes	What Might Have Caused Them?	Effect on the Environment

Describe the way the area around you looked: 25 years ago.
Describe how you think the area around you might look:
25 years from now.

Questions and Discussion:

1. Compile the changes noticed by various groups and compare the interpretations of the causes and effect.

TASK 7: (10 minutes) Work individually

Describe in writing how you feel about the changes in this environment.

D. Inferring Changes in a Rotten Log or Stump.

Using a rotten log or stump, answer the following questions and complete TASK 8 and TASK 9.

1. What things about this stump give us clues about the past events that have taken place?_____

_____

2. What factors caused these things to happen?_____

_____

TASK 8: (15 - 20 minutes) Work in groups of 4 or 5

What things are changing in the rotten stump now?
Record below:

Living Things	Effect on Stump
Non-Living Things	**Effect on Stump**

Questions and Discussions:

1. What cycles are taking place in the rotten log or stump?

TASK 9: (15 minutes) Work in groups of 4 or 5

In the space below construct a diagram of one of the cycles taking place in the rotten log or stump.

E. Transferring the Process to Other Environments

Questions and Discussion:

1. What are some other things in this environment that could help us further interpret the landscape and what it can tell us about the landscape?_____

_____

_____

TASK 10: (30 minutes) Work individually

Describe in writing an alternate activity you could have done to establish a time sequence for past events in this environment.

Describe in writing an activity you could do in a city environment to establish a time sequence for past events in the environment.

Activity	What It Could Tell About Past Events In The Area?

Describe an activity you could do in the area around your school to establish a time seqquence for the past events in the area.

Activity	What It Would Tell You About The Past Events In The Area?

F. Communicating Feelings of Awareness Through Sketching and Writing.

Using the material supplied, complete TASK 11 and TASK 12.

TASK 11: Work individually

Construct a sketch of anything significant in this environment.

TASK 12: Work individually

Find a place on your sketch to write:

a. 2 descriptive words about the object of your sketch
b. 3 action words about the object of your sketch
c. a short phrase that tells how the object affects the rest of the environment
d. 1 word that sums up everything about the object

G. Summary Questions:

1. What did we find out about the environment today?

2. Why are these things important to the way we manage the environment?

3. What are some of the big ideas that would sum up our investigation?

TASK 13:

Describe in writing how you feel about our session today?

ENVIRONMENTAL INVESTIGATION: Measuring Some Water Quality Criteria: An In-Service Training Environmental Investigation

Suggested Grade Level:

Suggested Study Area: Bays Mountain Park, Dickson School, Roller Woods

Equipment: Water testing kits, thermometers, lab sheets, dishpans, hand lens, 100 tapes, nets, screens, keys to aquatic life, maps, Golden Nature Guides

THEME: Water is a basic resource necessary for the survival of life.

Objectives:

As a result of these activities you should be able to:

Identify the boundaries of the area watershed on the map provided.

Using the list of aquatic animals found, and the water interpretation charts provided, predict the pH, temperature, and dissolved oxygen count of a water source.

Demonstrate the ability to test out the above predictions using a water analysis kit.

Measure the cubic feet of water per second flowing in a stream, and determine what size community of people could live off the amount of water determined.

Describe three ways the tested water source is important to the surrounding environment.

Describe in writing how man has affected the aquatic environment at this site.

Describe at least one action you can take in your everyday life to help improve the way water is managed:

in your home
in your community
in your consumer habits

Describe the benefits of each of the above actions.

PROCEDURE:

Introduction

In the next four hours we will investigate evidences of aquatic life in a given water supply, infer water temperature, O_2 and pH from that life, and then check out our inferences through experimentation. We will also determine the stream-flow of a stream, and discuss ecological, social, and political concerns of using such water.

A. Determining watershed boundaries.

Using the maps of the watershed area, completd TASK 1.

TASK 1: (15 minutes) Work individually or in small groups.

Find the watershed on the map.
Find your location.
Where does the water for this water supply come from?

_____
(If it is a stream, trace upstream to its source)
Draw lines on the map around the boundaries of the watershed.

B. Observing the aquatic environment.

Walk to the stream or water supply and record your observations of the aquatic environment by completing TASK 2.

TASK 2: (10 - 15 minutes) Work individually or in small groups.

As you approach the water supply, observe and record your observations:

Plants_____

Animals_____

Air_____

Rocks_____

Water_____

Questions and Discussion:

1. What is most noticeable about the water environment?

_____

2. Where were most of the plants growing?_____

_____

3. What did you notice about the rocks?_____

_____

4. Where did you see the bigger rocks?_____

_____

The smaller?_____

C. Observing aquatic animals

Questions and discussion:

1. What did you notice about the water?_____

_____

2. What do animals need to live in water?_____

_____

3. Where would you expect to find animals in this water?

_____

4. What guidelines need to be developed by our group as we collect animals from the water?

_____

TASK 3: (30 - 40 minutes) Work individually or in small groups.

Using available collecting equipment (sieves, nets, screens, etc.) Collect as many types of aquatic animals as possible. Put them in some type of container for observation by the group.

D. Identifying and recording aquatic animals

Using the Golden Nature Guides and the attached picture keys, generally identify the specimens you found.

TASK 4: (20 - 30 minutes) Work individually or in small groups.

On the lines below, list or sketch the animals you found.

Description of where found	Type (Name or sketch	No.

Return animals to the water as soon as you are finished.

Questions and discussion:

1. What animals did you find? Compile a group list. (preferably on a chart). Each person should record the group list on his lab sheet.

2. Where did you find most of the specimens?_____

_____

3. What similarities are there among the specimens?

_____

4. What differences did you find?_____

_____

5. What classification system could we use to classify the aquatic animals we found?_____

6. Would we be likely to find the same specimens in a different aquatic environment? Why or why not?

_____

_____

E. Predicting water characteristics from aquatic animals found

Questions and discussion:

1. What are some of the things animals need to live in water?_____

_____

Complete TASK 5:

TASK 5: (15 - 20 minutes) Work by yourself.

Based on the aquatic animals you found, and the charts below in the Analyzing Data Section, predict the following characteristics of this stream:

I predict:

the water temperature will be____ because_____
the air temperature will be_____ because_____
the pH number will be_____ because_____
the dissolved O_2 count will be____ because_____

Keep these predictions for your own reference.

Analyzing Data

pH RANGES THAT SUPPORT AQUATIC LIFE

	MOST ACID				NEUTRAL					MOST ALKALINE				
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Bacteria	1.0													13.0
Plants (algae, rooted etc.)					6.5									12.0
Carp, suckers, catfish, some insects					6.0					9.0				
Bass, crappie						6.5		8.5						
Snails, clams, mussels							7.0		9.0					
Largest variety of animals (trout, mayfly, stonefly, caddisfly)						6.5	7.5							

DISSOLVED OXYGEN REAUIREMENTS FOR NATIVE FISH AND OTHER AQUATIC LIFE

D. O in parts per million

Cold-water organisms including (trout) (below 68°)
- Spawning.....7 ppm and above
- Growth and well-being.....6 ppm and above

Warm-water organisms(including game fish such as bass, crappie) (above 68°)
- Growth and well-being.....5 ppm and above

TEMPERATURE RANGES(APPROXIMATE) REQUIRED FOR GROWTH OF CERTAIN ORGANISMS:

Temperature		Examples of Life
Greater than 68°. (warm water)		Much plant life, many fish diseases. Most bass, crappie, bluegill, carp, catfish, caddis fly.
less than 68° (cold water)	Upper range (55-68)	Some plant life, some fish diseases, trout, stonefly, mayfly, caddis fly, water-beetles, stridders
	Lower range (less than 55)	Trout, caddis fly, stone fly, mayfly

Questions and discussion:

1. Discuss, as a group, the range of predictions.

2. What were some of the criteria used to arrive at your predictions?

_____

3. How can we test our predictions?_____

_____

F. Testing our Predictions: Measuring and recording water characteristics -

With the testing equipment supplied, test the predictions you made previously. Instructions for using the kits are enclosed with the individual kits. Be sure samples are taken from different parts of the water source.

TASK 6: (20 - 30 minutes) Work in groups of 4-6 people.

Using the water test kit, determine the water temperature, air temperature, dissolved oxygen count, and pH of the stream. Record the data below: (also record predictions from Task 5 to compare)

Location of water sample (Edge or middle of stream)	Time Taken	Temperature				pH		Usable Oxygen(ppm)	
		Water		Air					
		My Pred.	Act Test	My Pred.	Act Test	My Pred	Act Test	My Pred	Act Test

MEASURING STREAMFLOW (Optional if the water source being studied is a stream)

Questions and Discussion:

1. What measurements do we need to know in order to determine the amount of water in this stream? (Discuss how to make different measurements.)
2. Predict how many people could live off the water in this stream._____

TASK 7: (45 minutes)

DETERMINATION OF STREAMFLOW

Instructions for collecting and recording streamflow measurements.

a. Measure and mark a 100 foot distance along a straight section of your stream. If you can't find a 100' section, use 25' or 50'. Throw a stick (2 or 3 inches long) in the water above the upstream marker. Record the number of seconds it takes to float downstream between the markers. Record below. Now divide the 100 foot distance by the total seconds it took the stick to float between the stakes.

100 ft. +_____ = _____ft. per second
(distance) (total seconds) (number of feet stick floated)
to float 100 ft. (each second)

b. Find the average width of your section of the stream. Measure the width of the stream at 3 places within the 100 foot area. Divide the total by 3 to get the average width of the stream.
First measurement_____feet.
Second measurment_____feet.
Third measurement_____feet.
Total _____feet + 3 =_____ft. (average width)

c. Find the average depth of your section of the stream. Measure the depth of the stream in at least 3 places across the stream in a straight line. Divide the total by 3 to get the average depth of the stream.
First measurement_____feet.
Second measurement_____feet.
Third measurement_____feet.
Total_____feet + 3 =_____ft. (average depth)

d. Find the cubic feet of water per second. Multiply the average width, average depth and the number of feet the stick floated each second.

_____ft. X	_____ft. X	_____ =	_____
Average Width	Average Depth	Number of Feet per Second	Cubic feet of water Flowing per second

Note: A cubic foot of water is the water in a container 1 foot wide, 1 foot high and 1 foot long, and contains 7.48 gallons

In order to find out how many people could live from the water in this stream, complete the following calculations.

_____ X	7.48 =	_____
Stream flow in Cu. ft. per sec.	Gallons in 1 cu. Ft. in minute	Gallons of water Per second

_____ X	60 =	_____
Gallons per sec.	Sec. in minute	Gallons of water per minute

_____ X	1440 =	_____ + *200 gal.=	_____
Gallons of water per min	No. min. in a day	Total gal. water per day	Amount of water 1 person uses per day	Total No. of people who could live from water in this stream

*The average person uses about 200 gal. of water a day for home use. This does not reflect each persons share of water used for industrial, public services and commercial.

Questions and discussion:

Have each group report the results of their tests to the entire groups. Compare results.

1. What might account for any differences in results from each group.

_____

2. How did your test results compare with your predictions?

_____

3. What can we say about the quality of this water supply?

_____

4. What else would we need to know to decide whether or not to drink this water?_____

5. Under what conditions might we expect to get different test results than we did today?

_____

_____

Questions and discussions:

1. If we were going to use this water, how much water should be left to flow down stream? Why?

2. What are some of the problems you encountered during this task?

H. Communicating feelings, awareness, and values about water -

Complete TASK H :

TASK 8: (10 - 15 minutes) Work by yourself.

1. Describe in writing how you feel about man's effect on the aquatic environment at this site:

2. Describe at least one action you can take in your everyday life to help improve the way water is managed:

   a. in your home:_____

   b. in your community:_____

   c. in your consumer habits:_____

3. Describe the benefits of each action in # 2.

I. Summary Questions

Complete TASK 9:

1. What did you find out about water from your investigations today?

2. Why is water important to the ecosystem?

3. How can we summarize our discussions and investigations?

4. What methods and processes did we use in our investigations today?

5. Describe in writing how you feel about our session today?

ENVIRONMENTAL INVESTIGATION: Soil Investigation In Land Use Planning. An In-Service Training Investigation

Suggested Grade Level: Elementary and Secondary

Suggested Study Area: Roller Woods, Bays Mountain Park, Dickson School

Equipment: Soil pH kits, micromonolith cards, tape measure, lab sheets, 3 sticks (50" or 100" long), jelly cups and lids, soil thermometers, 2 # 10 cans of water, hand lens, baby food jars, staplers, staples, 2 shovels, 3 yardsticks

THEME: Identification and interpretation of major soil areas is a basis for guiding orderly growth and development in a community.

Objectives:

As a result of these activities, you should be able to:

Describe ways in which the living organisms in the top part of the soil affect the soil.

Construct a soil micromonolith of an assigned soil profile, determine and record texture, structure, pH, temperature, and color of each layer.

Construct a written description of a soil you studied, using the words you recorded about that soil on your micromonolith.

Demonstrate the ability to determine the best uses of the land in this area, using the data from your soil micromonolith and the land capability charts.

Describe 3 things that man does to determine the proper management of the soil resource.

Describe how you feel about man's effect on this soil environment.

Describe how you feel about man's effect on the soil environment where you live.

Describe what you can do to improve the use of the soil:

in your backyard:
in your community:

PROCEDURE:

In the allotted time we will develop some skills and apply them to collecting and interpreting data about the soil environment and then apply that data to making some decisions about what the best uses of this land might be.

A. Describing Soil:
Upon arriving at the study area sit sown and do TASK 1:

TASK 1: (5 minutes) Work by yourself

Describe in writing your own description of soil.
Keep this description for your own reference at the end of the session.

B. Observing and recording things in the soil:
Using Task 2 below work in groups of 3 or 4 and report your findings in 15 minutes.

TASK 2: (15 minutes) Work in small groups.

1. Predict what things you will find in the top few inches of this forest floor. List your predictions.

2. Stake out an area 2 or 3 feet square on the forest floor and sift through the top 3 inches of the soil, recording the evidence of plants and animals you observe.

Name or Description of Item in the Soil	Quantity	Possible Effects on Soil

(continued)

Task 2 - continued

3. The following three terms are used to describe organic matter at the top of the soil: litter, duff, humus. From your study above, complete the following chart.

Term and definition	Describe the feel	List the identifiable parts of plants and animals you found
Litter (identifiable dead things on surface)		
Duff (partially decomposed organic matter - compacted)		
Humus (almost completely decomposed non-identifiable organic matter)		

Questions and discussion:

1. What did you find?_____

2. When would you expect to find more organisms? different organisms?

_____

_____

3. How do the organisms you found benefit the soil?_____

_____

4. What are some reasons for odors in the soil?_____

_____

C. Developing the Skills to Collect Soil Data

Questions and discussion:

Move to the soil profile.

1. What can you see as you look at the crossection or profile of soil?

_____

2. What are some things that would be important to find out about it?

_____

The observable characteristics of color, texture, structure, temperature and the acidity or alkalinity (pH) of a soil are indications of some soil conditions important in land use planning.

Collect and record some of this information. For the next few minutes work together as a group to develop skills in collecting soil data. After that, you will be working on your own.

Examples: (not necessary to discuss in this order)

1. Soil layers (Horizons)
   Mark where the soil changes color and looks. Many soils have three major layers or horizons, i.e. top soil, subsoil and parent material; because soil formation has many variables you may find more or less. (Measure and record the depth of each major layer).

   _____

   _____

   _____

2. Color
   Describe and record the texture of each major layer. (Have participants pick their own description of color)

   _____

   _____

   _____

3. Texture (How the soil feels)
   Determine and record the texture of each major layer.

   _____

   _____

   _____

   Texture is determined by feel(push and rub moistened sample between thumb and forefinger. Spit on sample to moisten.)

   If it feels gritty..... sand
   If it feels smooth and slick, not very sticky..... silt
   If it feels smooth, plastic, very sticky ..... clay

4. Structure (How the soil is put together)
   Determine the structure of each major layer. Carefully break apart a shovelful of soil from each layer and match its characteristics with one of the structure words on the lab sheet.

   _____

   _____

5. Temperature
Determine and record the temperature of each layer. Plant growth depends upon soil temperatures during the growing season. Find out your growing season before lesson.

6. pH (acidity or alkalinity)
Determine and record the pH of each major layer. Plants need many soil nutrients to grow well. The degree of pH affects how plants grow.

D. Constructing a Soil Micromonolith

Use the skills just developed to construct a soil micromonolith (a micromonolith is a small cross section of this profile). You can make one by just sketching the layers on the profile sketch in Task 3, or putting samples of each layer in a baby food jar, etc.
Notice there is a place to check or record the data you collect, and a place to sketch what the soil looks like.

TASK 3: (20 - 30 minutes) Work in small groups or by yourself.

Using the skills you have just developed, and the available equipment, construct a soil micromonolith of this soil profile. Record your observations on the soil micromonolith lab sheet. You may want to make a micromonolith using the cards and jelly cups; if so, ask your instructor.

When finished with this task, report to the instructor to receive TASK 4.

Air temperature 3 ft. above soil surface _____

Air temperature just above soil surface _____

Sketch your soil profile, label the layers or horizons and record the data.

PROFILE SKETCH

DATA

Contents of material above soil:_____ _____ , Depth_____" to_____".

A. (Horizon): Depth____"to____",clay_____
Topsoil
Texture: columns____, Blocky____, Platey____, Granules____. pH____, Temp.____, ____°F, Plant Roots Visible____.

Record below the same information above for the rest of the layers.

Describe type of rock in the bedrock (if present)_____

TASK 4. (20 - 30 minutes) Work in small groups or by yourself.

Use the soil data you collected and the following tables answer the following questions:

Effect of Soil Depth on Plant Growth and Water Storage

Deep Soil (over 42")	Excellent water storage and plant growth
Mod. Deep Soil (20"-42")	Good water storage and plant growth
Shallow Soil (20" & under)	Poor water storage and plant growth

The potential of my soil for water storage and plant growth is:
excellent____good____poor____
Why?_____

Some Relationship of Color to Soil Conditions

Top Soil Condition	Dark (dark grey, brown to black)	Moderately Dark (dark brown to yellow-brown)	Light (Pale brown, to yellow)
Amount of organic material	Excellent	Good	Low
Erosion factor	Low	Medium	High
Aeration	Excellent	Good	Low
Available Nitrogen	Excellent	Good	Low
Fertility	Excellent	Good	Low

Subsurface Soil Color (B Horizon)	Condition
Dull Grey (if in low rainfall soils)	Water-logged soils, poor aeration
Yellow, red-brown, black (if in forest soils)	Well drained soils
Mottled grey (if in humid soils)	Somewhat poorly to poorly drained soils

a. What can you say about the following, based on the color of the top soil, or A horizon?
amount of organic material_____
erosion factor_____
fertility_____

b. What can you say about the drainage in the B horizon, based on color?

_____

Effect of texture on Texture	Water holding capacity	Looseness of soil
Sand	Poor	Good
Silt	Good to excellent	Good
Clay	High(plants can't use it in clay)	Poor

My soil texture Soil water-holding capacity Looseness

Topsoil (A)

Subsoil (B)

Effects of structure on soil conditions

Type	Penetration of water	Drainage	Aeration
Columns	Good	Good vertical	Good
Blocky	Good	Moderate	Moderate
Granular	Good	Best	Best
Platey(low rainfall soils) (like stack of plates)	Moderate	Moderate	Moderate

Using the structures you recorded, and the chart, "Effects of Structure," what can you say about the drainage properties of your soil for:

Topsoil (A)_____

Subsoil (B)_____

1 4.5 6.5 7 8.5 14

(1 to 4.5 is too acid for most plants (Most plants do best here) (8.5 to 14 is too alkaline for most plants)

Example of plants in pH range:

pH 4.0 - 5.0: rhododendrons, camellias, azaleas, blueberried, fern, spruce

pH 5.0 - 6.0: pines, firs, holly, daphne, spruce, oaks birch, willow, rhododendron

pH 6.0 - 7.0: maple, mountain ash, pansy, asters, peaches, carrots, lettuce, pines, firs

pH 7.0 - 8.0: beech, mock orange, asparagus, sagebrush

Using the pH ranges you recorded and the table, "Examples of Plants in pH Range," complete the following chart:

Some Plants That Could Grow Here Based on the pH and Chart	Some Plants Actually Observed Growing Here

TASK 4: continued

Did your inferences about the soil pH-plant relationships check out?

yes____No____Explain:_____

Is pH the only factor affecting where plants grow? Yes____No____

Explain:_____

Describe in a short paragraph how you would set up an experiment to collect data and construct your own soil pH-plant relationship chart.

Soil Temperature

Soil Temperature	Conditions during growing season
Less than 40°F	No growth. soil bacteria and fungi not very active
40°F to 65°F	Some growth
65°F to 70°F	Fastest growth
70°F to 85°F	Some growth
Above 85°F	No growth

The growing season for my area is_____

What does the soil temperature chart tell you?_____

In the space below, convert the soil temperature table to a line graph. (5 - 10 minutes) Work by yourself.

F. DETERMINING SOME LAND USES

Questions and discussion: You have all the information you need except the slope of land, to discuss some land uses here.

Land Use Chart

This is a chart for soils in one kind of land, climate and plant. Other areas may require a different set of criteria.

Agriculature Uses	Slope	Erosion Hazard	Soil Depth	Drainage	Texture
Farm crops-cultivation good soil mngmt. practies	0-3	None	Deep	Well drained	Loam or silt loam
Fram crops-few to several special cultivation practices	3-20	Slight to moderate	Mod. deep	Somewhat poorly	Sandy loam or silty clay
Occasional cultivation many special practices	20-30	Severe	Shallow	Poor	Sand or clay
Pasture-woodland cultivation, no machinery can be used	0-2	None to slight	Deep	Well to poor	Stoney
Pasture, timber growing, woodland, wildlife, no cultivation machinery	30-90	Very severe	Deep to shallow	Well to poor	Sandy, silty, claying or rocky
Wildlife, recreation	all	None to extreme	Deep to shallow	Excessive to poor	Rockland, river wash, sand dunes

The most limiting soil factor will determine the best agricultural use of the land.

Occupancy land uses by man---

Man's valued uses of land has demanded criteria, in addition to agricultural uses, to determine proper management practices for living on the land. (Examples of others include: prescriptions for aesthetic management, soil site indexes for growing timber, criteria for greenbelts, etc.)

Some Uses & Factors Affecting That Use	Slight Limitation	Moderate Limitation	Severe Limitation
Roads and Streets			
Slopes	0 - 12%	12-30%	Over 30%
Depth	Over 40"	20-40"	Less than 20"
Watertable	Over 20"	10-20"	Less than 10"
Building Sites			
Slopes	0-12%	12-20%	Over 20%
Depth	Over 40"	20-40"	Less than 20"
Watertable	Over 30"	20-30"	Less than 20"
Septic Tank Filter Fields			
Slope	0-7%	7-12%	Over 12%
Depth	Over 6'	4-6'	Less than 4'
Watertable depth below trench	Over 4'	2-4'	Less than 2'
Picnic and Camp Areas			
Slope	0-7%	7-15%	Over 15%
Stones	0-20%	20-50%	Over 50%
Watertable during season of use	Over 30"	20-30"	Less than 20"

TASK 6: (20 minutes) Work in small groups.

Using the data from Task 4, Task 5, and the land use chart, answer the following questionss.

According to the agriculture and occupancy land use charts, this land could be used for:

Agriculture use:
(list & explain why)

Occupancy: (yes or no and with what limitations)

Roads and streets

Buidling sites

Septic tank filter fields

Picnic and camp areas

I feel the best uses of this land would be: (justify your answer)

Questions and discussions:

1. How have you classified this land?

2. Based on your observations and the data you collected, do you feel this land is being properly used?

3. In your estimation, have man's activities affected the classification of this land?

4. Could man improve the capability of this area? How?

5. How could man reduce the capability of this area?

TASK 7: (10 minutes) Work by yourself.

Using the words from the data you collected and recorded on the soil micromonolith card, write a description of the soil in your study. Compare this description with the one you wrote at the beginning of the session.

Questions and discussion:

1. What are some factors that contribute to soil formation?

2. What evidences of geological changes have you noticed in this area?

3. What other factors might affect uses of the land? (climate, growing season, needs of community, economic, past history of uses, etc.)

G. Communicating Feelings, Awareness, and Values About Soil

TASK 8: (10 minutes)

Describe what you can do to improve the use of the soil:

in your backyard.
in your community.

INTERPRETATION:

1. What did we find out about the environment in our study today?

2. How are soil characteristics important in environmental management?

3. How can we summarize our discussions and investigations?

4. What processes and methods did we use in our investigation today?

5. Describe in writing how you feel about our session today?

SOURCE MATERIAL

SOURCE MATERIALS

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